" Guided Urban Growth For Small Towns : An Area Based Development Strategy For Chhindwara "

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in partial fulfillment of the requirements for the award of the degree

Master of Technology
In
Urban Planning

By

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2024-25

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Declaration

I, **Rudra Lakhera,** hereby declare that this project titled **"Guided Urban Growth For Small Towns : An Area Based Development Strategy For Chhindwara"** is carried out by me in the **Department of Architecture and Planning** of Visvesvaraya National Institute of Technology, Nagpur. The work is original and has not been submitted earlier whole or in part for the award of any degree/diploma at this or any other Institution / University.

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- **Rudra Lakhera**

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Abstract

This study addresses the imperative for guided urban growth in Chhindwara, Madhya Pradesh, by employing Area-Based Development (ABD) strategies grounded in statutory planning and geospatial methodologies. Chhindwara's unregulated **peri-urban expansion** has resulted in spatial fragmentation, service delivery inefficiencies, and infrastructural strain—necessitating a structured intervention to redirect growth in a balanced manner.

The research aims to analyze existing urban development patterns, assess land suitability, and propose a strategic **ABD** framework to enable planned and balanced urban expansion. Methodologically, the study integrates multi-temporal GIS-based spatial analysis, including supervised classification of satellite imagery and demographic mapping, to assess urban sprawl trends between **2015 and 2025**. Further, **land cover simulations** and future growth projections using Cellular Automata-based models were undertaken to visualize and anticipate spatial transformations.

Insights from Gujarat's **Town Planning Schemes** (TP Schemes) mechanisms were adapted to the Chhindwara context, enabling the formulation of a locally grounded and legally adaptable spatial planning approach. Based on this framework, a peri-urban ABD zone was identified using land suitability analysis and proposed as a pilot intervention.

The ABD proposal incorporates **landuse zoning and road network**. Special attention was given to integrating the local ethnomedicinal economy by allocating zones for agro-processing and herbal industries. This study contributes to the evolving discourse on small-town planning in India by showcasing how **geospatial forecasting** and **statutory planning instruments** can synergize to ensure proactive, guided urban development.

Keywords : ***Area-Based Development, Guided Urban Growth, GIS Suitability Analysis, Land Cover Projection, Cellular Automata, Town Planning Scheme, Chhindwara, Ethnomedicines.***

Table Of Content

Chapter – 1 Summarizing Phase I 11

1.1 Background **11**

1.2 Classification of urban areas **12**

1.3 Aim of Phase I study **14**

1.4 Key Conclusions **14**

1.5 Takeaways from the case of Anand **17**

Chapter – 2 Background & Introduction **21**

2.1 Introduction **21**

2.2 Regional and Historical Background of Chhindwara **23**

Chapter – 3 Synopsis 27

3.1 Aim **27**

3.2 Objectives **27**

3.3 Research Query **27**

3.4 Methodology **27**

3.5 Need **29**

3.6 Need for Guided Urban Growth **31**

3.7 Scope **36**

3.8 Limitations **37**

Chapter – 4 City Profile 39

4.1 Municipal Area **39**

4.2 Planning Zones **39**

4.3 Population **43**

4.4 Urban Sprawl **45**

4.5 Existing Landuse **47**

4.6 Proposed Landuse 2035 ..... **49**

4.7 Economic Profile **52**

4.8 Ethno-Medicinal Market of Chhindwara **60**

Chapter – 5 Literature Review 66

5.1 Literature Summary **66**

5.2 Inferences **68**

Chapter – 6 Case Study : TP Schemes of Ahmedabad **72**

6.1 Area Delineation **72**

6.2 Fine Tuning TP Scheme Boundary **73**

6.3 Considerations for Delineating TP Scheme Boundaries **75**

6.4 Layered Analysis **77**

6.5 Case I **80**
6.6 Case II **81**
6.7 Case III **82**
6.8 Case IV **83**
6.9 Case V **83**
Chapter – 7 Survey and Primary Data Collection 85
7.1 Survey Form & Questionnaire **85**
7.2 Responses **90**
7.3 Key Observations **92**
Chapter – 8 Analysis 94
8.1 Landcover Projection using *Cellular Automata* **94**
8.2 Land Suitability Analysis **102**
8.3 Land Suitability Index **114**
Chapter – 9 Proposal and Recommendations 119
9.1 Schematic Road Network **119**
9.2 Schematic ABD LandUse Zoning **126**
9.3 TP Schemes Delineation **133**
9.4 Policy Recommendations **136**
9.5 Guided Landcover Projection using *Cellular Automata* **140**
9.6 Comparative Analysis **143**
9.7 Way Forward **145**
Chapter – 10 Summary 146

List Of Figures

Figure 1 Census Towns 11
Figure 2 Statutory Towns 11
Figure 3 Population wise Class division of small towns 12
Figure 4 Number of census and statutory towns in india 14
Figure 5 Table of key inferences from Phase I study 17
Figure 6 Maps showing Various TP schemes and growth of Anand city 20
Figure 7 Map showing location of Chhindwara in state of MP 25
Figure 8 maps and images showing chhindwara district and majot landmarks of the city 26
Figure 9 Flowchart of methodology 29
Figure 10 Urban sprawl in metrocoties of india 33
Figure 11 Haphazard road networks in metrocities of india 34
Figure 12 Concept of land readjustment 35
Figure 13 municipal area and wards of chhindwara 40
Figure 14 planning zones of chhindwara 42
Figure 15 population density of chhindwara 44
Figure 16 urban sprawl of chhindwara 46
Figure 17 existing land use 2023 of chhindwara 48
Figure 18 landuse areas ELU PLU and URDPFI 50
Figure 19 proposed land use of chhindwara 51
Figure 20 flowchart showing chhindwara's economic bases 55
Figure 21 news clippings showing ethnomedicinal markets of chhindwara 61
Figure 22 graphs showing various diseases cured and plants used for it 62
Figure 23 tp schemes of ahmedabad 73
Figure 24 tp scheme delineation 74
Figure 25 tp schemes delineation 02 76
Figure 26 map layers shwoing different factors affecting tp schemes 79
Figure 27 vinzol tp scheme 81
Figure 28 narol and hansol tps 82
Figure 29 nikol and prahalad nagar tps 84
Figure 30 primary data survey response 91
Figure 31 base raster layers 95
Figure 32 influencer raster layers 97
Figure 33 figures showing projected landcover and graph of neural network learning curve 100
Figure 34 projected landcover 2045 101
Figure 35 land parcel sizes 102
Figure 36 natural water drain 103
Figure 37 elu 2023 104
Figure 38 slope 105
Figure 39 aspect 106
Figure 40 landcover 2025 107
Figure 41 building footprint vs open land 108
Figure 42 national highway proximity 109
Figure 43 land values 110
Figure 44 state hioghway proximity 111
Figure 45 proposed roads proximity 2035 112
Figure 46 projected urban sprawl 113
Figure 47 land suitability 114
Figure 48 layer weight for overlay analysis 118
Figure 49 exisitng roads and major junctions 121
Figure 50 exisiting roads scenario 122
Figure 51 propsed roads 01 123

Figure 52 Proposed schematic road network 125
Figure 54 landuse industrial 130
Figure 55 landuse commercial 130
Figure 56 landuse PSP 131
Figure 57 Proposed ABD landuse plan 132
Figure 58 Proposed TP schemes delineation 135
Figure 59 projection of guided landcover changes and graph shwoing learning curve of neural netwrok training 141
Figure 60 projected guided landcover 2045 142
Figure 61 comparison maps of guided and unguided landcover projections 2045 144

List Of Tables

Table 1 Municipal area 39
Table 2 decadal population growth and composition 45
Table 3 GDP of chhindwara 52
Table 4 per capita income 54
Table 5 industrial division 57
Table 6 sector based contribution of workforce 58
Table 7 sector based contribution 59
Table 8 no. of licensed herbal units in india 63
Table 9 no. of traders and mandies 64
Table 10 literature review 01 70
Table 11 literature review 02 70
Table 12literature review 04 71
Table 13 literature review 03 72
Table 14 class weight for overlay analysis 117

Chapter – 1

Summarizing Phase I

1.1 Background

In 2018, a significant portion of the global urban population—**40.8%—**lived in urban centers with populations of less than **300,000**. Out of the global urban population of 4.18 billion, this represents approximately **1.7 billion people**, highlighting the importance of smaller urban centers in shaping global urbanization patterns.

In India, small towns play an equally crucial role in urban dynamics. **By 2011, around 181 million people, constituting nearly 50% of India's total urban population, resided in towns with populations under 500,000.** This reflects a strong concentration of the country's urban population in smaller towns rather than in metropolitan cities. Moreover, there were 1**,856 towns with populations ranging between 50,000 and 300,000**, holding a total of 136 million people. Projections estimate that by **2024**, this number will rise to **250 million, making up 20% of India's total population and 45%** of the urban population.

Between **2001 and 2011**, the urban population in India grew at an annual rate of **2.8%,** significantly outpacing rural growth, which stood at **1.2%.** This demonstrates a shift towards urbanization, driven by rural-to-urban migration and the transformation of rural

Figure 2 Statutory Towns

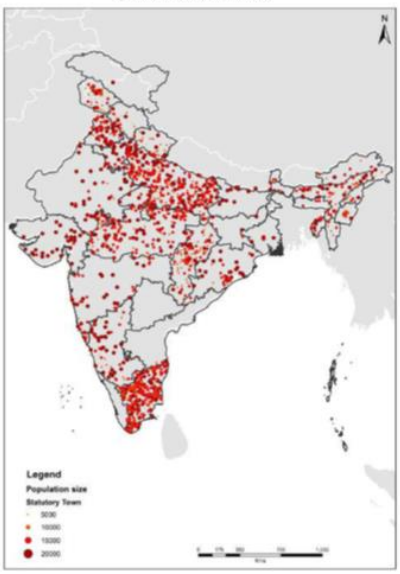
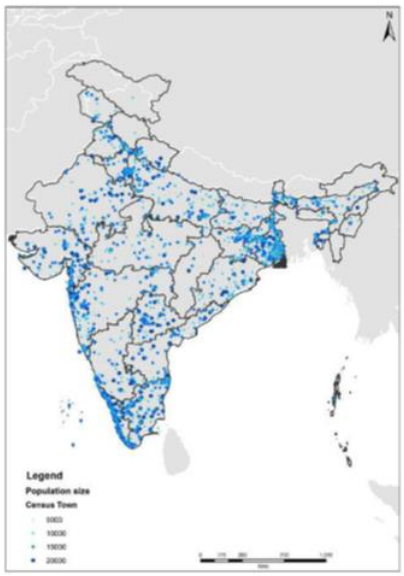


Figure 1 Census Towns



areas into urban spaces. Despite these significant contributions, the **4,500 urban local bodies (ULBs) in India only account for 7-10%** of total urban tax revenues, while contributing **15-20% of the national GDP**, highlighting the need for better fiscal policies to strengthen smaller towns economically.

1.2 Classification of urban areas

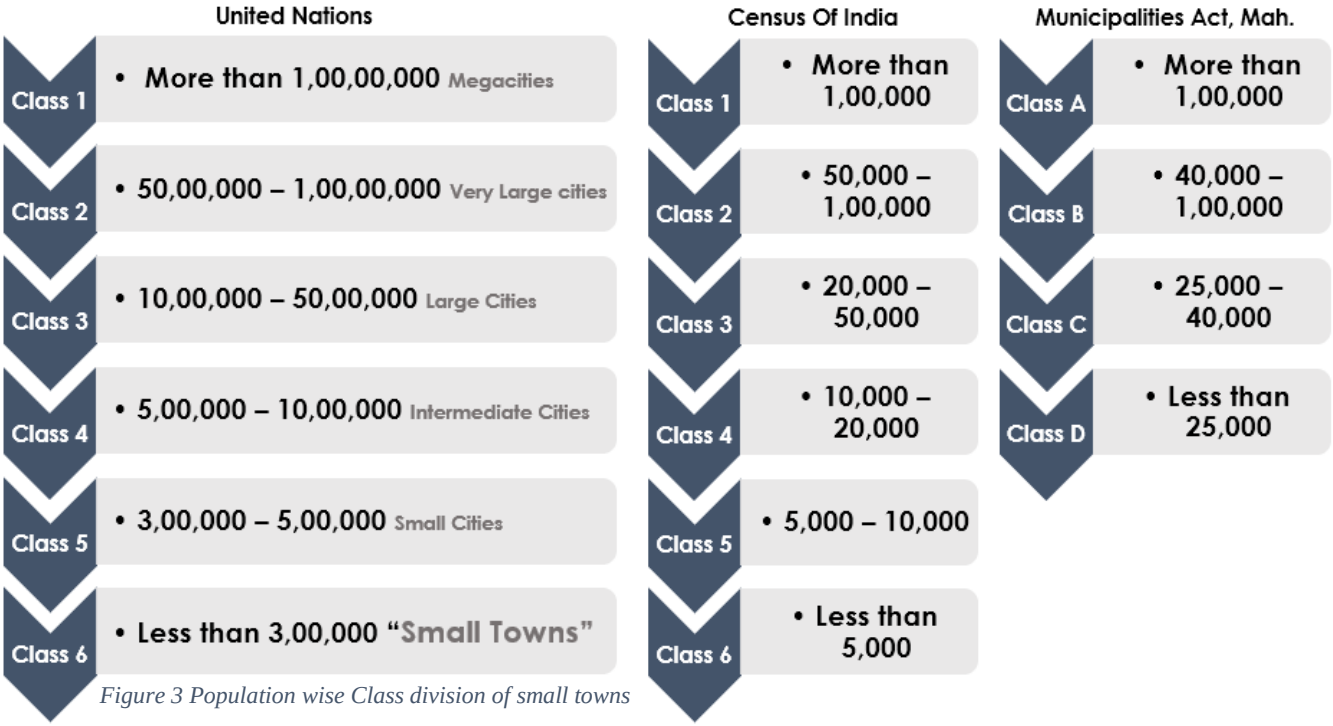


Figure 3 Population wise Class division of small towns

As India's urban landscape evolves, the traditional classification of large urban settlements, defined by a population of over **100,000**, no longer accurately reflects the complexity of contemporary population distribution. **Metropolises, such as Delhi and Mumbai, have grown into sprawling cities with populations in the tens of millions, overshadowing smaller urban centers that still fall within the old "large urban settlement" category.** This outdated classification fails to capture the immense scale and diversity within India's urban hierarchy.

To address this, it is more insightful to adopt the United Nations' (UN) classification system, which offers a more nuanced view of urban settlements based on varying population sizes. **The UN distinguishes cities on a spectrum from "small towns" (populations under 300,000) to "megacities" (populations exceeding 10 million).** This

approach provides a clearer understanding of urban structures, particularly in rapidly urbanizing countries like India, where population size and density are highly varied. By categorizing cities more precisely according to their size, policymakers and urban planners can better address the specific needs of different urban centers, such as infrastructure development, service provision, and housing, while also recognizing the distinct challenges faced by both smaller towns and massive metropolises.

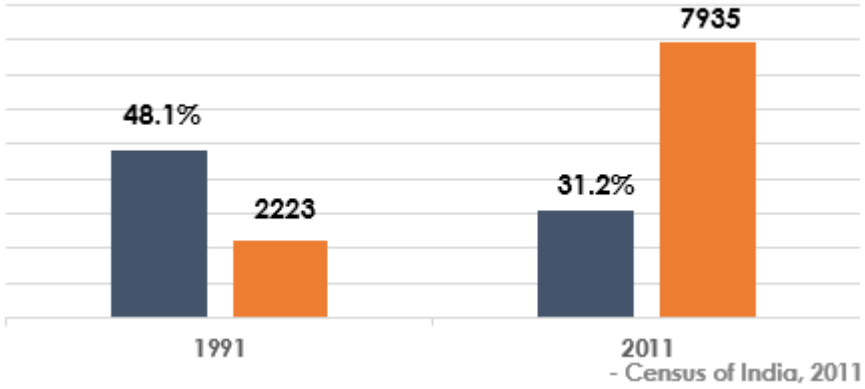
The urban population in India has become increasingly concentrated in large cities over the past several decades. **According to Chattopadhyay (2008), the growth rate of these cities has risen significantly, from 45% in the 1960s and 1970s to 62% in the 1990s and early 2000s.** This trend demonstrates the dominance of large cities in India's urban system, where economic opportunities, infrastructure, and services attract people from rural areas.

Despite the growth of large cities, the number of smaller towns has increased substantially. **In 1991, 48.1% of India's urban population lived in small towns, with only 2,223 such towns existing at the time.** By 2011, the number of towns had surged to **7,935,** but only **31.2%** of the urban population resided in these smaller urban centers. This shift indicates that while small towns are increasing in number, they are not retaining a proportionate share of the population, as more people are migrating to larger cities in search of better employment opportunities, improved quality of life, and greater access to services.

This migration pattern has put immense pressure on large cities, contributing to issues such as urban sprawl, overloaded infrastructure, housing shortages, and uncontrolled growth at the city's peripheries. The concentration of economic and population growth in large cities creates regional imbalances, leaving smaller towns underdeveloped. Therefore, for sustainable and balanced regional development, it is crucial to focus on the growth dynamics of small towns and implement interventions to bolster their development, potentially alleviating the burdens faced by larger cities and fostering more equitable urban

growth across the country.

Figure 4 Number of census and statutory towns in india



1.3 Aim of Phase I study

To analyse the physical and spatial growth patterns of small towns in Madhya Pradesh over the past decades.

A comparative evaluation of three small towns in Madhya Pradesh—**Sagar, Chhindwara, and Seoni**—with the objective of understanding how different physical, economic, and infrastructural parameters have influenced their urban growth over time. The analysis is conducted under six key thematic dimensions that collectively shape the development trajectory of small towns.

1.4 Key Conclusions

Urban Growth Constraints

The spatial development of these towns has been strongly shaped by the physical constraints inherent in their layout and geography. In **Sagar**, the presence of a large cantonment area, intersecting railway lines, and surrounding topographical barriers significantly hinder outward expansion. These physical divisions fragment the urban fabric and constrain the city's ability to sprawl uniformly, leading to patchy and uneven growth. In **Chhindwara**, the lack of a comprehensive ring road system and inadequate internal connectivity are major impediments to balanced urban development. The city suffers from disconnected zones, which prevent the efficient circulation of goods, people, and services. This weak internal network results in uneven land utilization and congestion in areas with better access, while inner parts remain underdeveloped or stagnant.

Seoni, by contrast, is restricted by its environmental context. Its proximity to the **Pench Tiger Reserve**, along with the undulating terrain, limits the scope for physical expansion. Regulatory restrictions designed to protect ecological zones act as invisible boundaries on urban spread, thus constraining growth while simultaneously preserving green buffers.

Economic Drivers

The economic profiles of these towns offer insight into their development potential and local livelihood patterns. **Sagar** shows limited industrial presence and remains economically dependent on traditional trade and small local businesses. The absence of major economic drivers hinders job creation and results in a modest urban economy that lacks resilience.

Chhindwara presents a more distinctive economic structure. The town supports a large **informal market centered around agro-based products and medicinal plants**. This local economy, although unorganized, plays a vital role in sustaining livelihoods and offers immense potential for future formalization and expansion. If supported through targeted policies and infrastructure development, this sector could evolve into a key economic pillar for the town.

In **Seoni**, economic activity is dominated by **agriculture and forest-based industries**, which reflect its semi-rural and ecologically sensitive setting. While these industries are foundational to the local economy, they also limit diversification and make the town's growth sensitive to environmental and seasonal variations.

Connectivity and Infrastructure

Infrastructure development and connectivity are essential for integrating urban areas and fostering economic growth. In **Sagar**, urban growth is severely affected by railway barriers that cut through the town. This has led to localized development concentrated in more accessible pockets, resulting in inefficient urban sprawl and service distribution.

In **Chhindwara**, the expansion of the city is largely influenced by the availability of highway connectivity. **Urban development tends to follow major highway corridors**, leading to a ribbon-like spatial pattern. However, this also means that **interior areas are left underutilized**, which creates a spatial imbalance and hampers the formation of a coherent urban core.

Seoni, on the other hand, enjoys relatively good highway access, which supports **linear**

urban growth. Nevertheless, this infrastructure remains poorly integrated with the town's interior regions. Hinterlands and low-density areas continue to suffer from development lag, indicating a need for a more distributed infrastructure network.

Topographical Challenges

Natural terrain continues to pose significant development barriers in many small towns. **Sagar** is surrounded by hilly regions, which makes horizontal urban expansion expensive and technically challenging. This elevates the cost of laying infrastructure and restricts the buildable area.

Chhindwara is relatively advantaged in this regard, as it **lacks significant topographical barriers**. The evenness of its terrain offers flexibility for expansion in multiple directions, provided supporting infrastructure is developed.

Seoni, conversely, faces acute topographical constraints due to the **Satpura Range**, which cuts through parts of the region. These highlands make construction more costly and reduce the availability of contiguous land for development.

Industrial Development

Industrial activity is a crucial factor in determining long-term urban growth and economic sustainability. **Sagar** continues to have **minimal industrial development**, with most of its economy tethered to local trade. This results in low industrial employment and a narrow economic base.

In contrast, **Chhindwara** shows signs of industrialization, particularly through its involvement in **coal mining and related industries**. However, this has led to a pattern of **economic dependency**, where the town's fortunes are tied to the performance of a single sector. While such industries bring employment and investment, they also create risks related to economic mono-dependence and environmental degradation.

Seoni exhibits limited industrialization, largely dominated by **small-scale and forest-linked industries**. These industries lack the scalability needed to significantly impact urban transformation but provide consistent employment for rural and peri-urban populations.

Expansion Potential

The capacity for future expansion is one of the most telling indicators of long-term urban

sustainability. In **Sagar**, the **southwestern direction has been identified** as the most viable route for expansion, likely due to relatively accessible terrain and fewer physical obstructions.

Chhindwara holds significant potential in its **northwestern and southern corridors**, where emerging industrial clusters and available land make these zones ideal for guided urban growth. These areas could be transformed into productive urban zones if complemented by improved infrastructure and zoning measures.

In contrast, **Seoni** lacks a clearly defined direction for future growth. **Environmental restrictions and topographical limitations** have made it difficult to chart a concrete expansion path. Urban planning efforts in Seoni must therefore be carefully balanced with ecological preservation goals and terrain-sensitive development practices.

Aspects	Sagar	Chhindwara	Seoni
Urban Growth Constraints	Cantonment area, railway lines, and geographical constraints limit expansion.	Lack of ring roads and poor internal connectivity hinder balanced growth.	Proximity to Pench Tiger Reserve and topography restricts urban growth.
Economic Drivers	No major industries; limited to trade and local businesses.	***Informal market for agro-based products and medicinal plants, supports local economy.***	Agriculture and forest-based industries dominate the economy.
Connectivity & Infrastructure	Hindered by railway barriers; growth concentrated in limited areas.	***Urban expansion occurs along major highways, leaving inner areas underutilized.***	Highway connectivity supports linear growth but hinterlands remain underdeveloped.
Topographical Challenges	Surrounded by hills restricting spatial expansion.	No significant topographical barriers affecting urbanization.	Satpura Range restricts spatial growth and increases infrastructure costs.
Industrial Development	Minimal industrial development; economy dependent on local trade.	***Coal mining and industries create economic dependency.***	Limited industrial base; small-scale industries dominate.
Expansion Potential	Southwest direction identified for future expansion.	Industrial corridors in the northwest and south support expansion.	No clear expansion direction due to environmental constraints.

Figure 5 Table of key inferences from Phase I study

1.5 Takeaways from the case of Anand

The city of Anand in Gujarat presents a unique case study in how targeted economic interventions and planned urban mechanisms can influence the spatial and economic evolution of a small town. Over the decades, Anand has transitioned from a modest settlement into a vibrant urban node, catalyzed by industrial innovation, educational infrastructure, and structured planning. The analysis of Anand's historical urban growth

highlights significant lessons for guiding small-town development elsewhere.

Evolution of Growth Drivers and Urban Form

Anand's transformation can be understood through three major time periods, each marked by a distinct set of growth drivers and corresponding spatial responses.

1925–1950:

During this period, Anand's traditional **gamtal** or urban core experienced congestion, prompting a spillover of growth into peripheral areas. A landmark event was the **establishment of the Amul Dairy** and the **Gujarat Agriculture University**, located approximately 8 kilometers from the gamtal. These two institutions served as powerful economic anchors, drawing workforce migration, investments, and support services. This development initiated the **emergence of satellite urban areas** and new economic sub-centers outside the congested core. As a result, urban activity began decentralizing and radiating outward from the original city nucleus.

1950–1975:

The second phase of Anand's growth was marked by a wave of **industrialization**. This economic shift resulted in a substantial increase in the town's growth rate, particularly fueling urban sprawl in the **southern and northern directions**. Industrial employment and housing demand encouraged the development of previously underutilized lands, reshaping the urban footprint of the town beyond its traditional limits.

1975–2001:

The third and most transformative period followed the **establishment of the Anand Area Development Authority (AADA)**. Under its jurisdiction, the city adopted formal **Town Planning (TP) schemes** as the primary mechanism for guiding growth. This led to **planned urban development across all directions**, featuring zoned infrastructure, road networks, and clear segregation of industrial, residential, and commercial uses. TP schemes abutted the edges of the gamtal and restructured growth along rationalized urban layouts. This planning intervention allowed for more efficient land use and connectivity, ensuring that future expansion occurred in an organized and balanced manner.

Role of Institutional and Sectoral Anchors

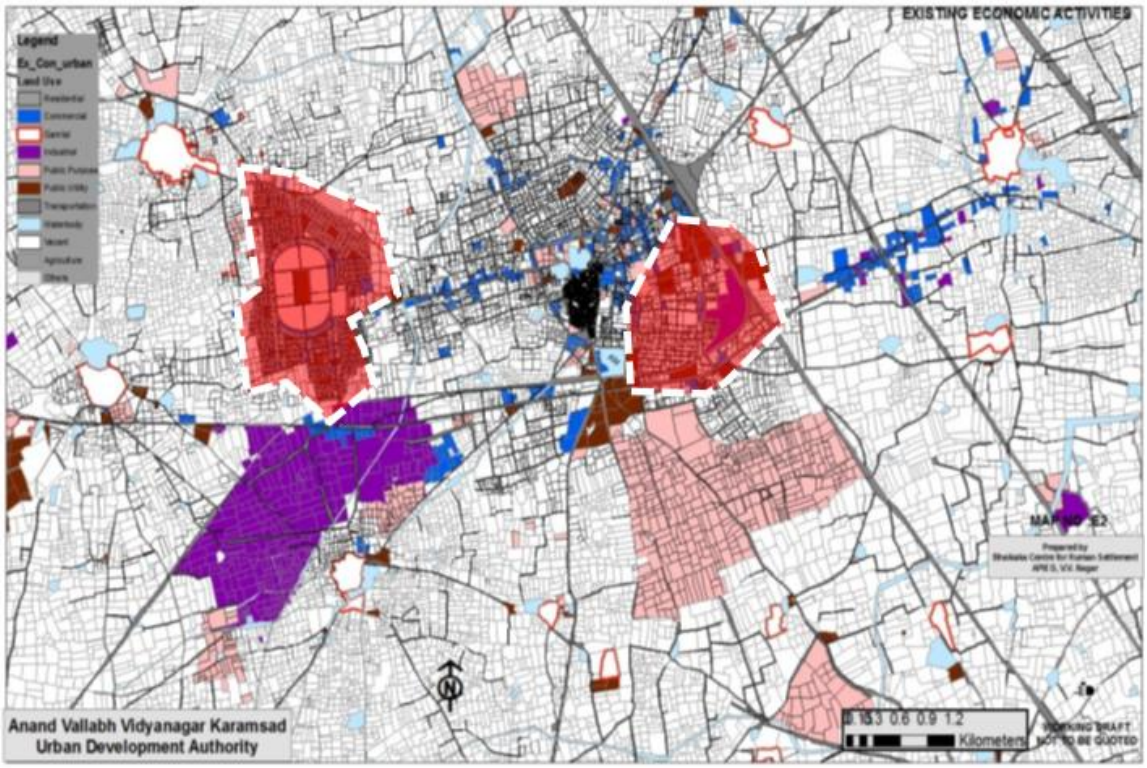
Several pivotal institutions played a defining role in Anand's growth story:

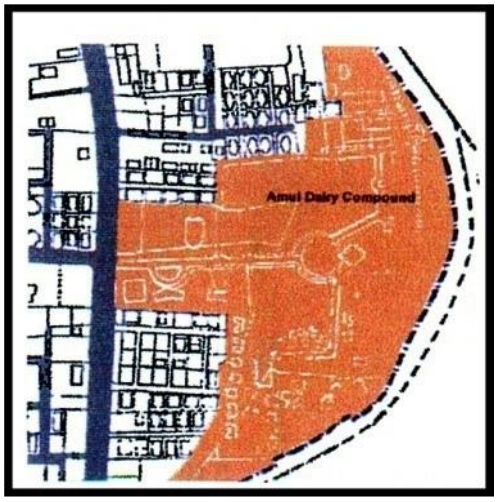
- **Amul Dairy's Economic Impact:**
- The rise of Amul and Polson Dairy Co-operatives positioned Anand as a **national dairy hub**, significantly driving employment, private investment, and the proliferation of **allied agro-industrial sectors**. These co-operatives provided economic resilience to the city and attracted a skilled labor force.
- **Educational Influence of Vallabh Vidyanagar:**
- The formation of **Vallabh Vidyanagar**, a planned university town, was a major stimulus to the city's socio-economic fabric. By attracting students, faculty, and educational institutions, this node fueled demand for **housing, commerce, and services**. It also diversified the town's demographic base, contributing to a more cosmopolitan character and reinforcing its image as a knowledge-oriented settlement.
- **Vitthal Udyognagar Industrial Area:**
- Located adjacent to Anand, **Vitthal Udyognagar** further added to the town's economic dynamism by creating industrial employment zones and enhancing regional trade. It served as an extended industrial estate complementing the core city's economy.

Impact of Town Planning Schemes (TP Schemes)

One of the most instructive lessons from Anand lies in its use of TP schemes as an urban management tool. Since the mid-1970s, **six TP schemes were introduced between 1975 and 1982**, primarily in areas bordering the gamtal. These schemes not only provided structured land subdivision but also promoted a **new paradigm of development** focused on **high-rise and vertical growth**, maximizing land utilization.

By zoning for diverse uses and aligning growth with infrastructure networks, the TP schemes ensured **planned spatial expansion**, supported by proper road hierarchies, open spaces, and service networks. This approach effectively transitioned Anand from a congested core-centric town into a **well-distributed urban system** with functional sub-centers.





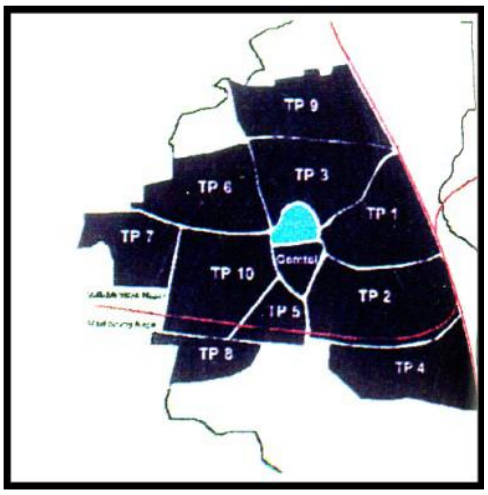


Figure 6 Maps showing Various TP schemes and growth of Anand city

Chapter – 2

Background & Introduction

2.1 Introduction

The rapid urbanization of India is not limited to large metropolitan areas; small towns have also witnessed significant demographic and spatial transformation. Between 2001 and 2011, over 2,500 new census towns emerged, primarily due to rural areas organically developing urban characteristics without corresponding governance structures (*Census of India 2011*, *MoHUA*). This unplanned transition has resulted in a host of structural and spatial planning issues that continue to hinder the full potential of small towns.

Infrastructure Deficiency

Over 60% of small towns in India are reported to lack basic urban services, including safe drinking water, underground sewerage, and reliable solid waste management systems. The absence of essential infrastructure impairs not only quality of life but also economic productivity and urban sustainability (*AMRUT Service Level Benchmarks, MoHUA, 2021*).

Unregulated Land Use and Real Estate Growth

A major concern in small-town development is the unregulated conversion of land, particularly in peri-urban areas. Without adequate oversight, land use changes often result in informal and haphazard settlements that deviate from planned zoning principles (*TCPO, 2019*). Weak enforcement mechanisms further aggravate the issue, leading to the proliferation of unauthorized colonies and real estate sprawl.

Proliferation of Informal Housing

Due to limited housing supply and inefficient planning norms, slums and informal settlements now constitute a significant portion of residential structures in small towns. Many of these settlements lack secure tenure and essential services, reinforcing social inequality (*NSSO 69th Round, 2013, MoHUA Slum Data*).

Economic Integration Issues

Unlike larger urban centers that benefit from diversified economies, small towns often fail to integrate their economic activities into the spatial planning process. Industrial areas are poorly sited, logistics networks are weak, and economic nodes develop without coordinated policy backing. This undermines both economic performance and urban form (*UN-Habitat & MoHUA, India Habitat III Report, 2016*).

Town Planning Implementation Gaps

While states like Gujarat and Maharashtra have successfully implemented Town Planning Schemes (TPS) and land pooling models for organized growth, most small towns in India do not follow such structured planning tools. As a result, growth remains fragmented, irregular, and infrastructure-deficient (*CEPT University, "Land Readjustment: An Effective Tool", 2014*).

In addition, Master Plans are either absent or outdated in many towns. These planning documents, even where available, often fail to reflect current population trends and emerging land demands, making them ineffective tools for guiding spatial development (*TCPO, 2022*).

Central Scheme Neglect and Planning Mismatch

Central government programs like JNNURM and AMRUT initially focused almost exclusively on large cities. Small towns were brought into the fold only in later phases, creating a significant gap in funding and administrative support (*MoHUA Scheme Guidelines, World Bank Review of JNNURM, 2014*).

The absence of proper integration into national schemes, coupled with poor access to technical planning tools, has led to mismatches between real-time development pressures and the town's formal planning frameworks.

Technological and Institutional Shortcomings

Urban planning in small towns is still largely manual and data-deficient. The use of GIS or remote sensing for land use mapping is rare, resulting in inaccurate zoning decisions and spatial miscalculations (*IIHS, 2019*). Moreover, peri-urban areas that are functionally urban continue to be administered under rural governance structures, such as Panchayati Raj Institutions, which are ill-equipped for urban service delivery and planning (*ICRIER, "Urbanization Beyond Cities", 2018*).

Regional Disparities and Metro Dependence

Finally, the poor management of growth in small towns exacerbates regional inequality. It causes a disproportionate concentration of investment and opportunity in metropolitan centers, increasing the country's dependence on metros and leaving smaller towns underdeveloped and outpaced (*NITI Aayog, Strategy for New India @75, 2018*).

2.2 Regional and Historical Background of Chhindwara

The city of **Chhindwara**, located in the southern part of Madhya Pradesh, stands out as one of the most prominent districts in the **Satpura range**. It is also recognized as the **largest district in Madhya Pradesh in terms of area**, lending it significant administrative and geographical importance. Strategically positioned with road linkages to key urban centers such as Nagpur, Jabalpur, and Bhopal, Chhindwara functions as a vital regional node in central India.

Geographical Setting

Chhindwara's terrain is characterized by forested plateaus, undulating hills, and river valleys. The district borders Maharashtra to the south and is connected via major national highways, including **NH 347** and **NH 547**, which facilitate inter-state trade and mobility.

The **map visuals** illustrate Chhindwara's regional placement with reference to its neighboring districts, road infrastructure, and major landmarks such as the **Tribal Museum**, **Railway Station**, **Raymond Textile Plant**, and **Deogarh Fort**. The city's location at the interface of the Satpura hills and the plateau edge has historically made it both strategically important and ecologically rich.

The etymology of *Chhindwara* is said to derive from the abundant presence of **'Chhind' trees** (wild date palms) in the region. The suffix "*Wada*," meaning place, suggests that the area was historically known as a land full of these trees—*Chhind-Wada*, which eventually became Chhindwara.

Historical Timeline and Cultural Evolution

Chhindwara boasts a **rich and layered historical legacy**, shaped by successive waves of regional dynasties and empires. A brief chronological overview helps contextualize its socio-political transformation:

Vakataka Rule (3rd Century CE) :

- The earliest known political control of Chhindwara is attributed to the **Vakatakas**, who ruled the region until the 3rd century CE. Their influence extended across large parts of central India and laid the foundations for regional cultural and administrative structures.

Rashtrakuta Influence (Post-3rd Century) :

- After the decline of the Vakatakas, **southern Chhindwara** came under the control of the **Rashtrakutas**, who remained dominant for several centuries. This period witnessed the consolidation of trade routes and temple architecture in parts of central India.

Gauli Control (Late 7th Century CE) :

- The **Gaulis**, a pastoral community, gradually gained control by the end of the 7th century CE. Their rule is noted for transitioning the region toward a more localized governance model rooted in agrarian practices.

Gond Dynasty (14th Century Onwards) :

- One of the most influential indigenous regimes, the **Gond Dynasty**, made **Deogarh** a prominent stronghold. The Gonds established a strong socio-political base in Chhindwara, fostering indigenous culture, military defense systems, and decentralized governance structures.

Mughal and Maratha Periods (17th–18th Century) :

- The region experienced a period of **internal conflicts and external interventions**, with both the **Mughals and Marathas** seeking to assert dominance. This era brought shifts in revenue administration, fortification, and trade flows.

British Annexation (1803) :

- In the early 19th century, Chhindwara was **annexed by the British**, following the defeat of the Bhosale rulers. It was merged with the Central Provinces and annexed alongside Nagpur. This period marked the introduction of colonial land records, new taxation regimes, and railway infrastructure.

Post-Independence Transition (1956) :

- After India's independence, **Chhindwara became part of the state of Madhya Pradesh** in the 1956 reorganization. This realignment integrated it more directly into state-level planning and administrative networks.

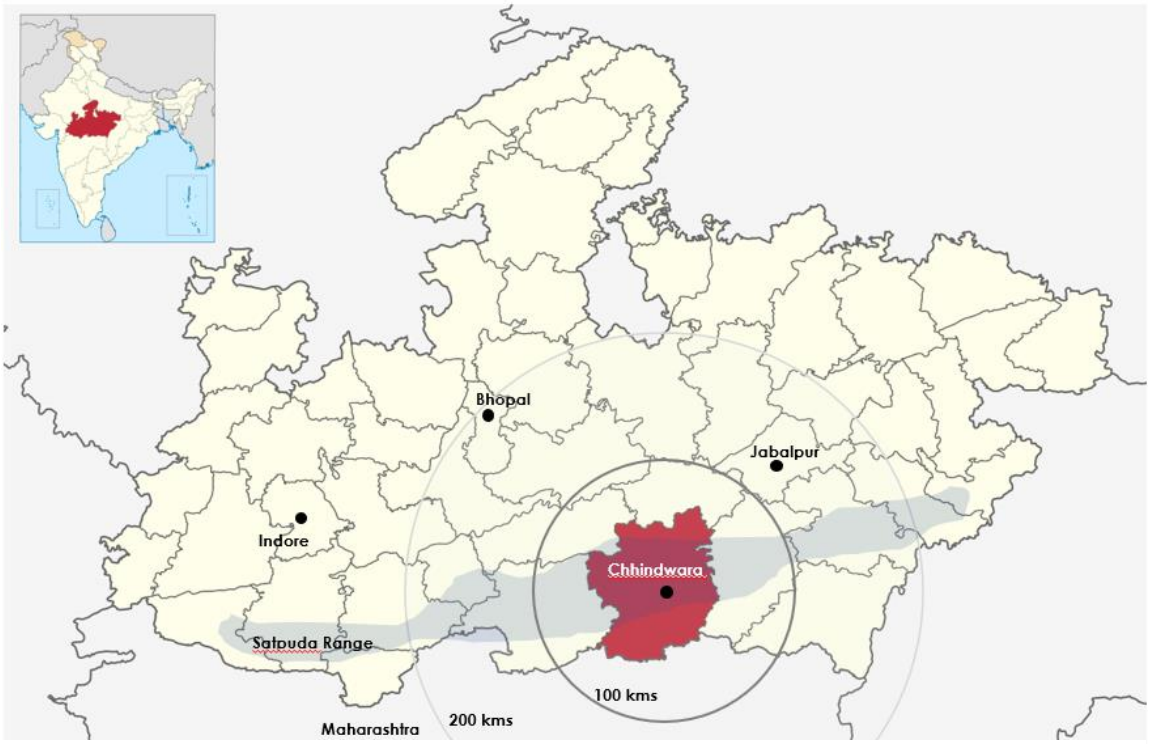
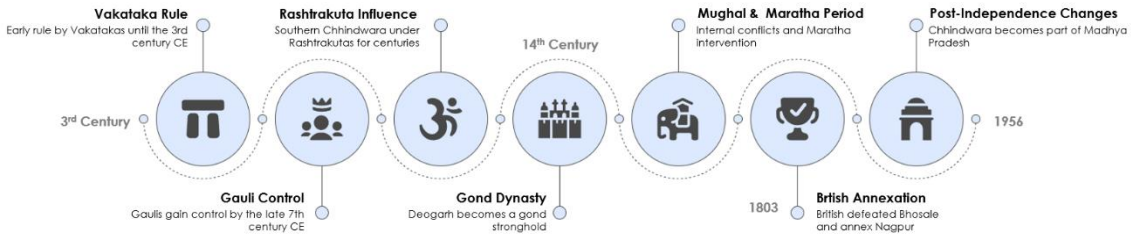


Figure 7 Map showing location of Chhindwara in state of MP



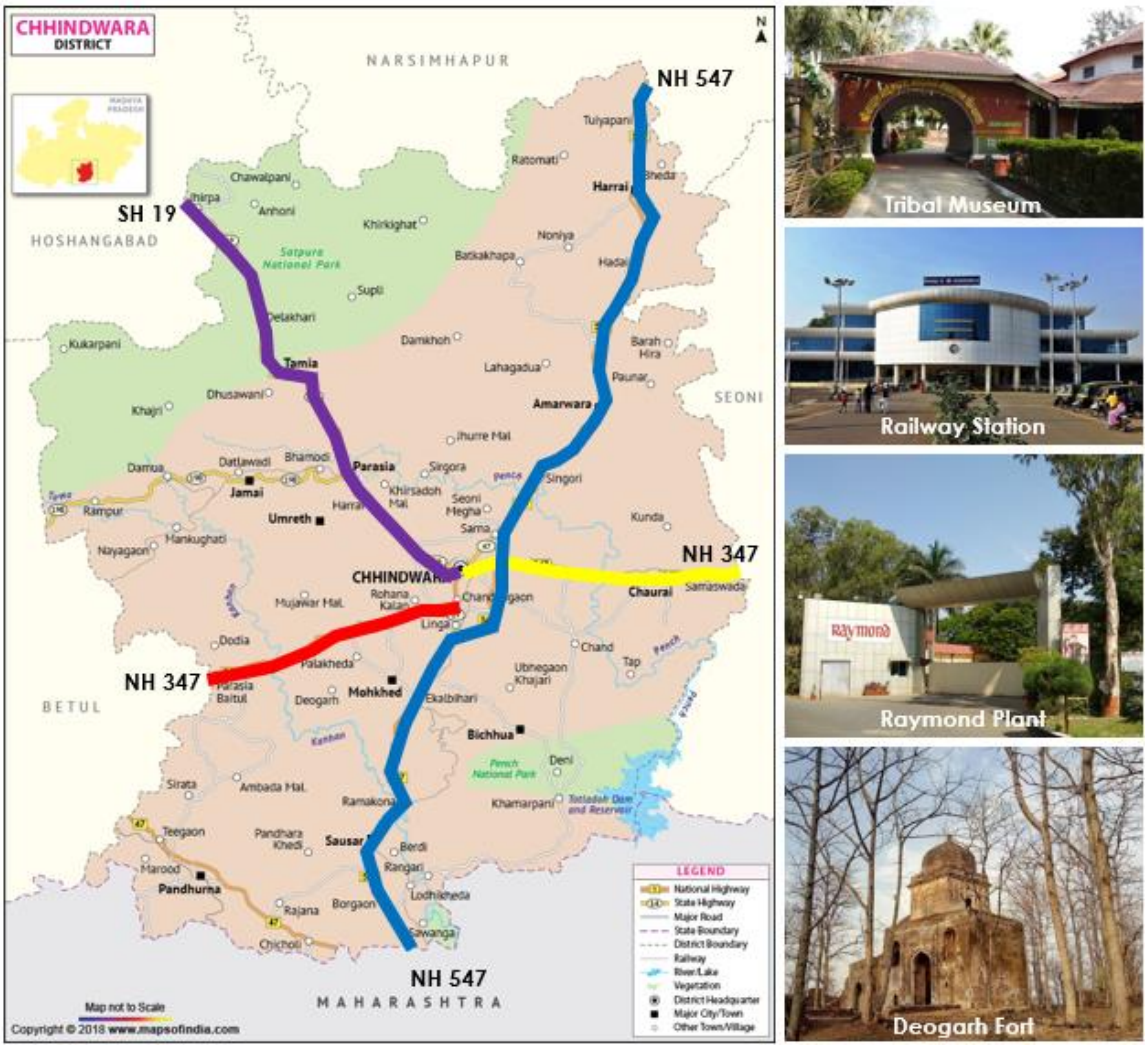


Figure 8 maps and images showing chhindwara district and majot landmarks of the city

Chapter – 3

Synopsis

3.1 Aim

To develop an Area-Based Development strategy to guide the planned physical urban growth of Chhindwara city.

3.2 Objectives

1. To analyze the **existing physical growth pattern and economic bases** of Chhindwara.
2. To understand the **concepts and techniques** related to **various tools of ABD.**
3. To conduct a **land suitability analysis** and **simulate urban growth** using **GIS-based raster datasets and LULC techniques.**
4. To propose an **Area-Based Development strategy for structured land-use planning,** control the organic sprawl pattern and achieve a **guided urban growth** of Chhindwara.

3.3 Research Query

1. How can an **ABD strategy** be applied to **regulate urban sprawl** and guide planned physical growth of Chhindwara?
2. What **GIS-based methodologies** can be used to conduct a **land suitability analysis** for selecting optimal ABD strategies?
3. How can **Economic attractors** and **Town Planning Schemes (TPS)** be adopted for planning an ABD?

3.4 Methodology

The methodology follows a logical progression from problem identification to proposal formulation, integrating theoretical grounding, case learning, spatial analysis, and planning tools.

Problem Delineation and Study Area Selection

The study began by defining the **aim and objectives**, followed by clarifying the **scope and limitations**. A **literature review** of existing planning frameworks, policies, and urban development issues in small towns shaped the research foundation. Concurrently, a **study area** was selected based on thematic relevance, planning potential, and current urban challenges.

Theoretical and Case Study Analysis

The research incorporated a **review of related planning concepts** such as land readjustment, town planning schemes, and economic zone planning. **Best practices and case studies** were analysed to extract applicable strategies, supplemented by relevant **research papers and reports** to inform contextual insights. Key observations and inferences guided the methodological direction.

Tools, Data Framework, and Focus Area

Based on this grounding, **tools and techniques** like **GIS-based land suitability analysis** were employed. A **framework for data collection** was also developed, along with a review of relevant **policy guidelines** such as AMRUT and URDPFI.

These inputs helped delineate the **focus area**, selected for its economic activity, infrastructure gaps, and land potential.

Proposal Development

Finally, **planning proposals** were formulated, aiming to address the identified urban challenges through structured spatial interventions and policy-aligned tools such as TP schemes and mixed-use zoning.

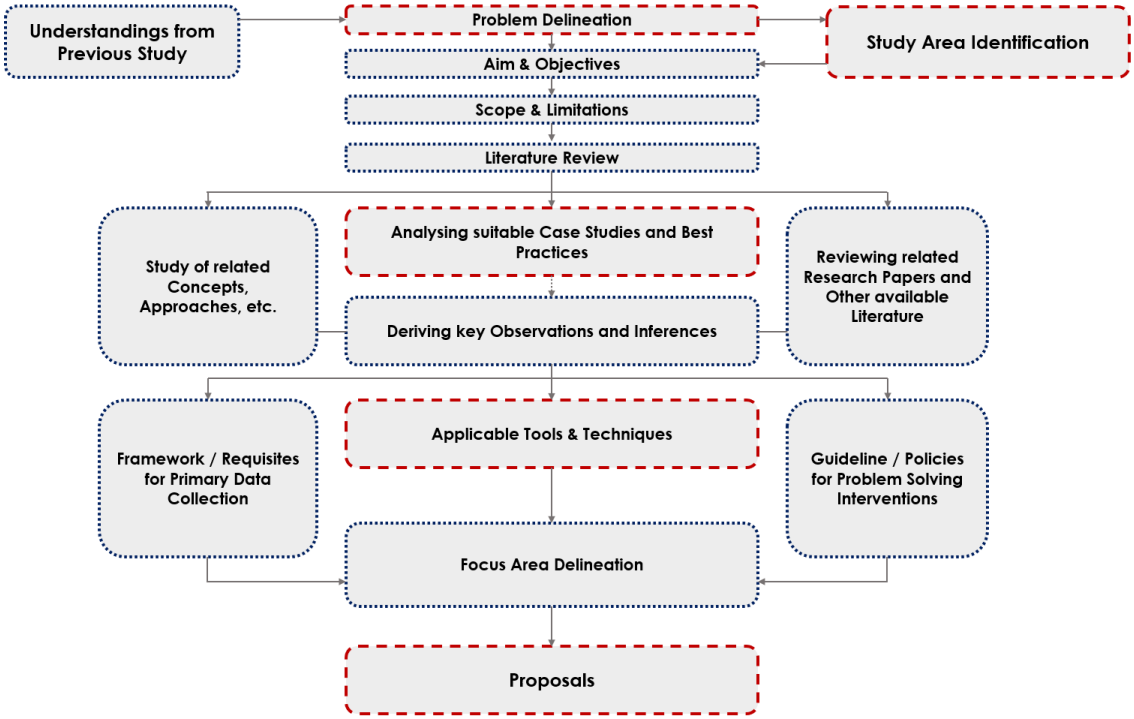

Understandings from Previous Study
Problem Delineation
Study Area Identification
Aim & Objectives
Scope & Limitations
Literature Review
Study of related Concepts, Approaches, etc.
Analysing suitable Case Studies and Best Practices
Reviewing related Research Papers and Other available Literature
Deriving key Observations and Inferences
Framework / Requisites for Primary Data Collection
Applicable Tools & Techniques
Guideline / Policies for Problem Solving Interventions
Focus Area Delineation
Proposals

Figure 9 Flowchart of methodology

3.5 Need

Chhindwara city has witnessed steady spatial growth over the past few decades, but this expansion has largely been **unplanned, fragmented, and informal in nature**. Without a structured framework to channel development, the city's spatial spread and economic potential remain underutilized. This study identifies four core reasons that establish the **urgent need for a planned intervention** to support guided urban transformation and economic rejuvenation in Chhindwara.

1. Guided Urban Growth

One of the most pressing challenges in Chhindwara is the **absence of a defined urban growth structure**. The expansion of the city has taken place in a spontaneous and reactive manner, often influenced by road-side ribbon development or private layouts, rather than being led by strategic planning or zoning regulations. This has resulted in an **uncoordinated spread of settlements**, especially toward the outskirts, where infrastructure and public services are either missing or inefficiently distributed.

Such unregulated sprawl leads to inefficient land use patterns, increased service delivery

costs, and long-term pressure on core infrastructure systems like water supply, sewage, and solid waste management. Without spatial hierarchy or a zoning logic, residential, commercial, and industrial activities often emerge in mixed pockets, giving rise to **conflicting land uses and degraded environmental conditions**. Therefore, a model of **guided urban growth**, supported by land pooling mechanisms, TP schemes, and infrastructure-led zoning, is critical to bring spatial order and sustainability to the city's future development.

2. Absence of an Economic Node

Despite its location advantage and proximity to regional hubs like Nagpur, Chhindwara does not function as a defined **economic or employment node** within the region. Economic activity in the city is largely scattered and informal, with **no formal industrial estate** serving as a central employment generator. Agro-forestry trade, minor forest produce, household industries, and herbal medicine markets exist, but in **dispersed and unregulated forms**.

This **lack of economic clustering** reduces productivity, limits opportunities for value addition, and prevents integration into regional and national supply chains. Furthermore, because these activities are unrecognized in the formal planning process, they remain outside the scope of infrastructure development and policy support. Establishing planned **economic hubs or industrial clusters** would enable better organization of productive sectors, promote job creation, and enhance the city's economic identity.

3. Controlling Urban Sprawl

Chhindwara's current development pattern reflects the classic symptoms of urban sprawl—low-density, horizontal expansion, largely driven by land speculation and informal layouts. Such sprawl **undermines compact development**, leads to land underutilization in core areas, and increases travel distances, which in turn raises the cost and carbon footprint of infrastructure and mobility networks.

Uncontrolled sprawl also makes it difficult to extend services like drainage, waste management, and street lighting, leading to a disparity in service standards across the city. In the absence of regulatory tools like urban growth boundaries, density controls, or guided land readjustment, the town's expansion continues in a fragmented fashion. Containing and redirecting this growth through **planned densification**, introduction of mixed-use

transit corridors, and structured public open space networks is essential for long-term resilience.

4. Strengthening Economic Bases

Chhindwara has significant latent potential in sectors like **agro-forestry, herbal medicine trade, and small-scale manufacturing**, but it suffers from serious **infrastructure and institutional gaps** that prevent these sectors from scaling up. The lack of processing units, cold storage, packaging centers, and organized wholesale markets results in the **export of raw goods rather than finished products**, reducing value capture within the local economy.

Additionally, the city's **logistics infrastructure is inadequate**, with limited connectivity to warehousing and transport corridors. This not only weakens the local economy but also reduces its appeal for private investment. At the same time, while Chhindwara is geographically close to major regional centers like **Nagpur, Betul, and Jabalpur**, its **linkages with these cities remain underdeveloped** in terms of coordinated transport and economic integration.

There is thus a pressing need to build **economic leverage through stronger inter-city connectivity**, and to create local growth hubs that align with these corridors. Investments in logistics parks, agro-processing zones, and market facilities—aligned with land use planning—would significantly strengthen the city's economic base and regional role.

3.6 Need for Guided Urban Growth

India's rapid urbanization over recent decades has led to significant challenges, particularly due to the prevalence of **unplanned** and **haphazard urban expansion**. This unregulated growth has resulted in **infrastructural strain**, **environmental degradation**, and **socio-economic disparities**. Recognizing these issues is crucial for formulating strategies that promote **sustainable** and **inclusive urban development**. *(Times of India, 2023)*

Consequences of Unplanned Urban Expansion

1. Infrastructural Strain

Unplanned urban growth often leads to **inadequate infrastructure**, including insufficient **water supply**, **sanitation**, **transportation**, and **electricity**. The lack of foresight in urban planning results in **overburdened systems** that cannot meet the demands of the growing population, leading to decreased **quality of life** for residents. *(Buildings & Cities Journal, 2022)*

2. Environmental Degradation

The unchecked expansion of urban areas encroaches upon **natural habitats**, leading to **loss of biodiversity**, increased **pollution**, and heightened vulnerability to **natural disasters**. The destruction of **green spaces** and **water bodies** exacerbates **urban heat islands** and reduces the **ecological resilience** of cities. *(Buildings & Cities Journal, 2022)*

3. Socio-Economic Disparities

Informal settlements often emerge in unplanned urban areas, lacking **basic services** and **legal recognition**. Residents of these areas face challenges such as **insecure tenure**, limited access to **education** and **healthcare**, and exclusion from **formal economic opportunities**.
(Down To Earth, 2024)

The Imperative for Guided Urban Growth

To address the challenges posed by unplanned urbanization, a shift towards **guided urban growth** is essential. This approach involves **strategic planning** and implementation of policies that ensure **orderly development**, **equitable distribution of resources**, and **environmental sustainability**.
(MoHUA & TCPO, 2020)

1. Land Readjustment and Town Planning Schemes

Land readjustment, as exemplified by **Town Planning Schemes (TPS)** in Ahmedabad, involves **pooling land parcels**, **reconfiguring them for optimal use**, and **redistributing them** among original owners with **improved infrastructure**. This method facilitates the provision of **public amenities** and **equitable development** without resorting to **compulsory land acquisition**.

(Lincoln Institute of Land Policy, 2018)

2. Integration of Economic and Spatial Planning

Aligning **economic development** with **spatial planning** ensures that growth is both **inclusive** and **sustainable**. By designating **zones** for **industrial**, **commercial**, and **residential use**, and by providing necessary **infrastructure**, cities can promote **balanced development** and reduce **socio-economic disparities**. *(Asian Development Bank, 2019)*

3. Environmental Considerations

Incorporating **environmental considerations** into urban planning is vital for **resilience against climate change** and **natural disasters**. Preserving **green spaces**, implementing **sustainable drainage systems**, and promoting **public transportation** can mitigate **environmental degradation** and enhance the **quality of urban life**. *(Buildings & Cities Journal, 2022)*

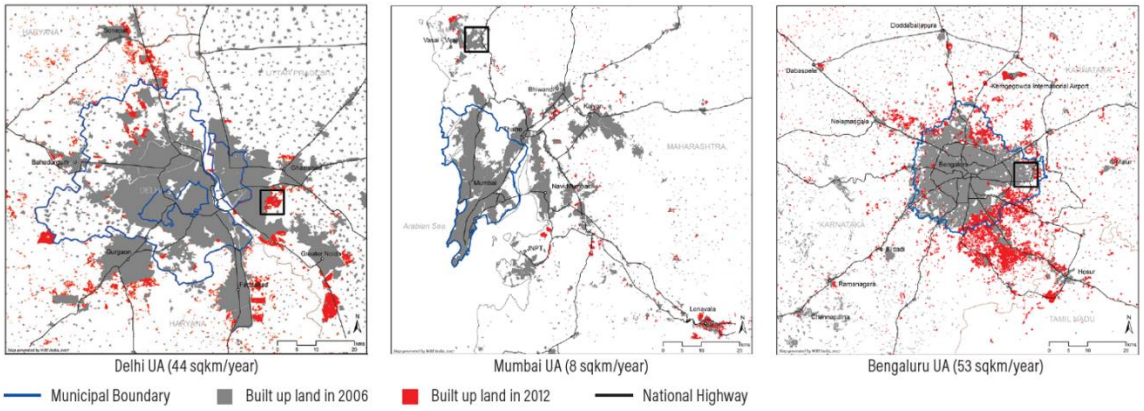


Figure 10 Urban sprawl in metrocoties of india

Peripheral Disarray and the Absence of Structured Growth

The pattern of urban growth in India increasingly shows that **population and built-up areas are expanding faster in peripheral zones** than within the core areas of large metropolitan cities. These urban fringes lie outside formal administrative boundaries and are often beyond the direct reach of structured planning frameworks. *(MoHUA, 2021; IIHS, 2019)*

These **urban peripheries** undergo **rapid land conversion** driven by market speculation and population pressure. This often results in the **haphazard growth of slums, unauthorised colonies**, and **piecemeal commercial developments**. There is typically an

unregulated mix of **conforming and nonconforming land uses**, further complicated by the **absence of adequate infrastructure, services, and public facilities**. *(TCPO, 2019; Down To Earth, 2024)*

Given these challenges, **unplanned growth must transition into planned and serviced urban extensions**, supported by **infill development strategies** that reduce infrastructure redundancy. Without such transformation, cities risk permanent lock-in to **unsustainable infrastructure networks** and prohibitively **expensive retrofitting** requirements. *(UN-Habitat & CEPT, 2016)*

This calls for proactive planning that provides **urban land with structured road networks, physical infrastructure, and essential social amenities** such as schools, healthcare, parks, and transit stops. Such provisioning must be guided by principles that prioritize the **common public good** over individual land interests. It is within this **purview of public purpose** that guided urban growth becomes not only desirable but necessary. *(Urbanization Beyond Cities, ICRIER, 2018)*

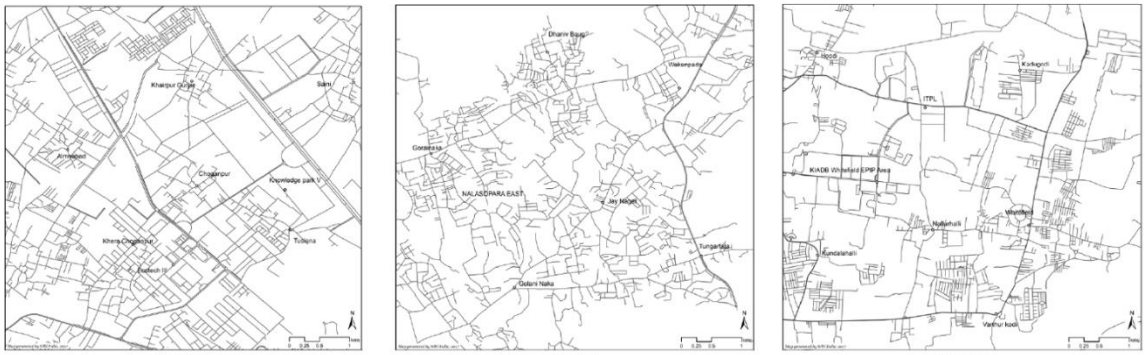


Figure 12 Haphazard road networks in metrocities of india

Conventional infrastructure development in peri-urban areas, particularly when implemented through **land acquisition** for arterial roads, often results in **uneven and inefficient development**. As illustrated in the figure, the construction of a single arterial road under such methods can **leave rural land parcels fragmented and unsuitable for integrated urban use**. This outcome disproportionately benefits only those whose land abuts the new road, while others are **economically and spatially excluded**. *(Lincoln Institute of Land Policy, 2018; MoHUA, 2020)*

The parcels that **do not adjoin the arterial road** remain **isolated and underutilized**, despite the **substantial public investment** made in road construction. This generates **land value inequality**, limits future land use conversion, and undermines the return on

infrastructure expenditure. Without comprehensive planning, **access is not guaranteed**, even where road infrastructure is physically present. *(ADB, 2019; CEPT University, 2014)*

To address this, a **land readjustment-based area development approach** provides a more effective framework. In this approach, **land parcels are voluntarily pooled**, restructured into **regular and buildable shapes**, and redistributed to the original owners in smaller but **more valuable and accessible forms**. Importantly, this mechanism also **sets aside land for road hierarchy, open spaces, and public utilities**, thereby ensuring collective benefit. *(UN-Habitat, 2016; Lincoln Institute of Land Policy, 2018)*

Such an approach achieves multiple objectives:

1. It **reconfigures land** into **regular or rectangular parcels**, which are better suited for construction and service provision.
2. It ensures **equitable access to road networks** for all landowners, not just those adjacent to the original alignment.
3. It enables provision of **social amenities** such as **parks, schools, and public buildings**, offering a more inclusive and **livable urban environment**. *(ADB, 2019; Urbanization Beyond Cities, ICRIER, 2018)*

In doing so, **land readjustment transforms passive rural land into service-ready urban fabric**, while respecting ownership and avoiding the displacement and resistance often associated with forced land acquisition. For towns like **Chhindwara**, where large peri-urban tracts await integration into the urban system, this tool is not only viable—it is imperative for sustainable and balanced expansion. *(MoHUA & TCPO, 2020)*

Before: Proposed Road Alignment
After: Without Land Readjustment
Inefficient and inequitable development
After: With Land Readjustment
Opportunity to plan, service and finance development.
All landowners benefit.

Figure 14 Concept of land readjustment

3.7 Scope

1. The study focuses on identifying a suitable **peri-urban site** within Chhindwara MC limits for **Area-Based Development (ABD)** using **GIS-based land suitability analysis** tools (DEM & LULC).
2. It explores the **application of Town Planning Schemes (TPS)** for spatial organization of land use to support mixed-use, industrial, and public amenity zones.
3. The study emphasizes **integrating economic clusters**—especially forest-based and agro-linked industries—within the proposed ABD area to reinforce existing economic strengths.
4. The outcome of the study is to provide a **planning framework** for small towns facing unmanaged sprawl and weak economic spatial alignment.

The present study focuses on addressing the challenges of unstructured urban expansion and fragmented economic development in small towns through a **site-specific, planning-driven approach**. The city of **Chhindwara**, a district headquarters located in the Satpura region of Madhya Pradesh, serves as the case context for testing and demonstrating this approach.

1. Identification of a Peri-Urban Site for ABD

A key scope of the study is to **identify a suitable peri-urban site** located within the administrative limits of **Chhindwara Municipal Council (MC)** for implementing an **Area-Based Development (ABD)** strategy. The selection of the site is guided by **GIS-based land suitability analysis**, using tools such as **Digital Elevation Models (DEM)** and **Land Use Land Cover (LULC)** data. These geospatial methods help determine the optimal land parcels based on terrain, existing land cover, connectivity, and development potential. The goal is to ensure that the identified ABD site aligns with both spatial logic and economic feasibility.

2. Application of Town Planning Schemes (TPS)

The study further aims to explore the **application of Town Planning Schemes (TPS)** within the proposed ABD site. The TPS mechanism is employed to **restructure the land**

into organized zones, enabling a balanced mix of **residential, industrial, and public amenity uses**. This approach also facilitates infrastructure planning (roads, utilities, public spaces) and ensures equitable redistribution of land value among stakeholders. The TPS model provides a practical and implementable pathway to formalize peri-urban expansion in a financially and socially inclusive manner.

3. Integration of Economic Clusters

Another important aspect of the study is the **integration of local economic strengths** into the spatial planning framework. Chhindwara is known for its forest-based resources and a thriving **informal market in agro-linked products**, particularly traditional herbal and forest produce. The proposed ABD site will seek to embed **economic clusters** related to **agro-processing, herbal medicine, and allied industries** within the land use layout. By doing so, the study aims to reinforce Chhindwara's unique economic identity while also formalizing and scaling its informal sectors.

4. Development of a Replicable Planning Framework

Finally, the broader objective of the study is to develop a **replicable planning framework** that can be used by other small towns facing similar challenges of **urban sprawl, land fragmentation, and weak economic spatial alignment**. The model demonstrated through Chhindwara is intended to bridge the disconnect between economic activity and spatial form—delivering more structured, economically viable, and service-ready growth for small and medium urban centers in India.

3.8 Limitations

While the study proposes a strategic, spatially integrated model for Area-Based Development (ABD) in Chhindwara, it is important to acknowledge certain inherent limitations that influence the scope, accuracy, and applicability of the findings and proposals.

1. Spatial Scope Restricted to a Selected Peri-Urban Area

The proposals and interventions outlined in this study are **limited to a defined peri-urban zone** identified within the **municipal limits of Chhindwara**. This zone was selected

through land suitability analysis to serve as the focus area for ABD implementation. As a result, the study does not attempt to assess or propose development interventions for the **entire urban extent of Chhindwara**, nor does it address **rural hinterland dynamics or village-level interactions** in detail. Broader regional interlinkages are acknowledged conceptually but are not part of the analytical framework or planning proposals.

2. Reliance on Secondary Data Sources

The study is primarily based on **secondary data**, including government-published statistics (Census of India, Economic Surveys), satellite imagery, development reports, and policy documents. While these sources provide a valuable macro-level understanding, they may **not fully capture the evolving ground realities**, particularly in fast-changing informal sectors or unrecorded spatial transformations.

The absence of **primary field surveys or stakeholder interviews** due to logistical or institutional limitations further restricts the ability to validate observed trends or incorporate community perspectives into the planning process. Consequently, the findings should be interpreted as indicative, with a recommendation that future implementation phases incorporate updated field-level data and participatory planning inputs for validation and refinement.

Chapter – 4

City Profile

4.1 Municipal Area

Municipal Area and Administrative Growth

The administrative journey of Chhindwara reflects a steady evolution from a small urban jurisdiction to a fully-fledged municipal corporation. The **municipality was first established in 1967** under the provisions of the **Madhya Pradesh Municipal Act, 1961**, covering an area of **11.33 square kilometers**. Over the years, urbanization and administrative reforms warranted the elevation of this municipality to a **Municipal Corporation**, which was officially declared on **28 August 2014**.

To accommodate the expanding urban footprint and to integrate nearby peri-urban settlements, the jurisdiction was **expanded to include 24 surrounding villages**. The city's **Planning Area was formally constituted on 14 November 1973** and was later expanded on **24 April 2014** to include an additional **13 villages**, leading to a total of **28 settlements** (27 villages + core urban area).

Today, the **Chhindwara Municipal Corporation is organized into 48 wards**, covering both urban and partially rural populations. The **total planning area spans 12,380 hectares**, of which **11,073 hectares** are urban and **1,308 hectares** are rural. As per the **2011 Census**, the total population within the planning area was **2,23,163**, with the **urban population comprising over 96%**, signifying the city's dominant urban character.

Category	Total	Municipal (Urban)	Rural
Area (in ha)	12,380	11,073	1,308
Population (2011)	2,23,163	2,15,843	7,320

Table 1 Municipal area

4.2 Planning Zones

Planning Zones and Investment Units

To streamline spatial planning, land management, and infrastructure investment, Chhindwara's planning area has been divided into **three Investment Units** or **Planning**

Zones, each reflecting distinct connectivity corridors, land characteristics, and development potential. These zones are color-coded on the planning map and are designed to balance immediate and future land use needs.

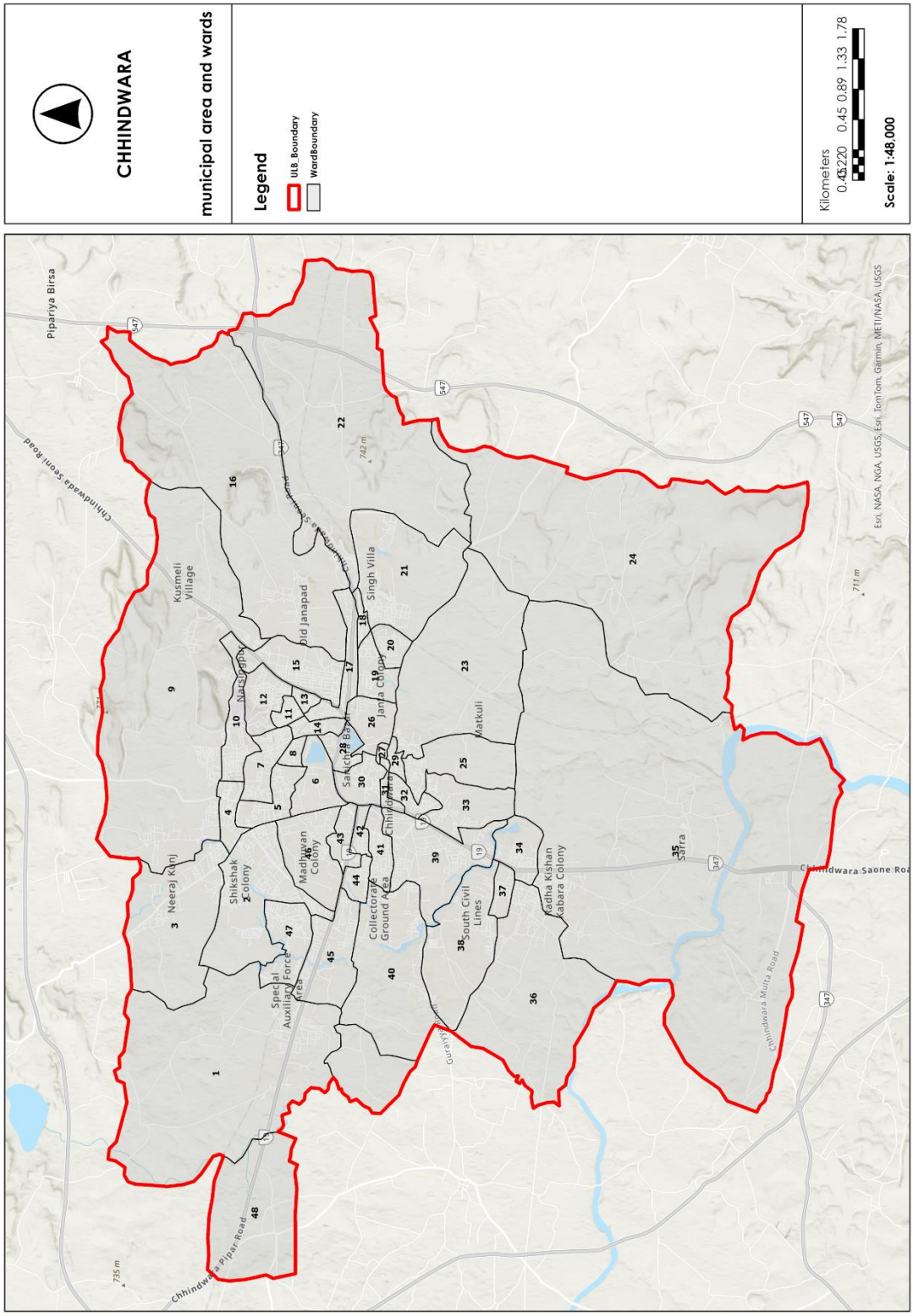


Figure 16 municipal area and wards of chhindwara

Investment Unit 1 (Zone 1 - Red Zone)

- **Location**: Oriented along the **Parasia–Narsinghpur** route in the northern part of the city.
- **Key Facilities and Landmarks** :
    1. Government residential quarters, Circuit House, S.P. Battalion, MPSEDC-plotted areas
    2. Old bus stand, **Doordarshan Center**, Radio Station, Women's Polytechnic, SSC Office
    3. Educational institutions like Govt. College, Girls' Campus, and **Kendriya Vidyalaya**
- **Land Use Distribution** :
    1. **Total Area**: 4,357.00 ha
    2. **Proposed Area for Development**: 1,539.93 ha
    3. **Future Reserved Area**: 2,817.07 ha

Investment Unit 2 (Zone 2 - Blue Zone)

- **Location**: Strategically located between **Narsinghpur and Nagpur routes**, this central-east zone serves as a transitional corridor.
- **Key Facilities and Landmarks** :
    1. Industrial and service-based facilities like **Gandhi Nagar**, Sugar Mill, **Chopan Nagar**
    2. Major infrastructure like Sewage Treatment Plant, Agricultural Research Center
    3. Logistic and transport hubs such as Transport Nagar and Agriculture Produce Market
- **Land Use Distribution** :
    1. **Total Area**: 4,126.50 ha
    2. **Proposed Area for Development** : 1,387.45 ha
    3. **Future Reserved Area** : 2,739.05 ha

Investment Unit 3 (Zone 3 - Green Zone)

- **Location**: Spanning across southern and southwestern sectors, aligned with **Nagpur, Parasia, and Seoni** routes.
- **Key Facilities and Landmarks** :
    1. Institutional and economic anchors such as Central Jail, ITI, Film City plot

2. Peripheral agricultural estates like **Bharatada** and **Lahwani Farm**

- **Land Use Distribution** :
    1. **Total Area**: 3,896.00 ha

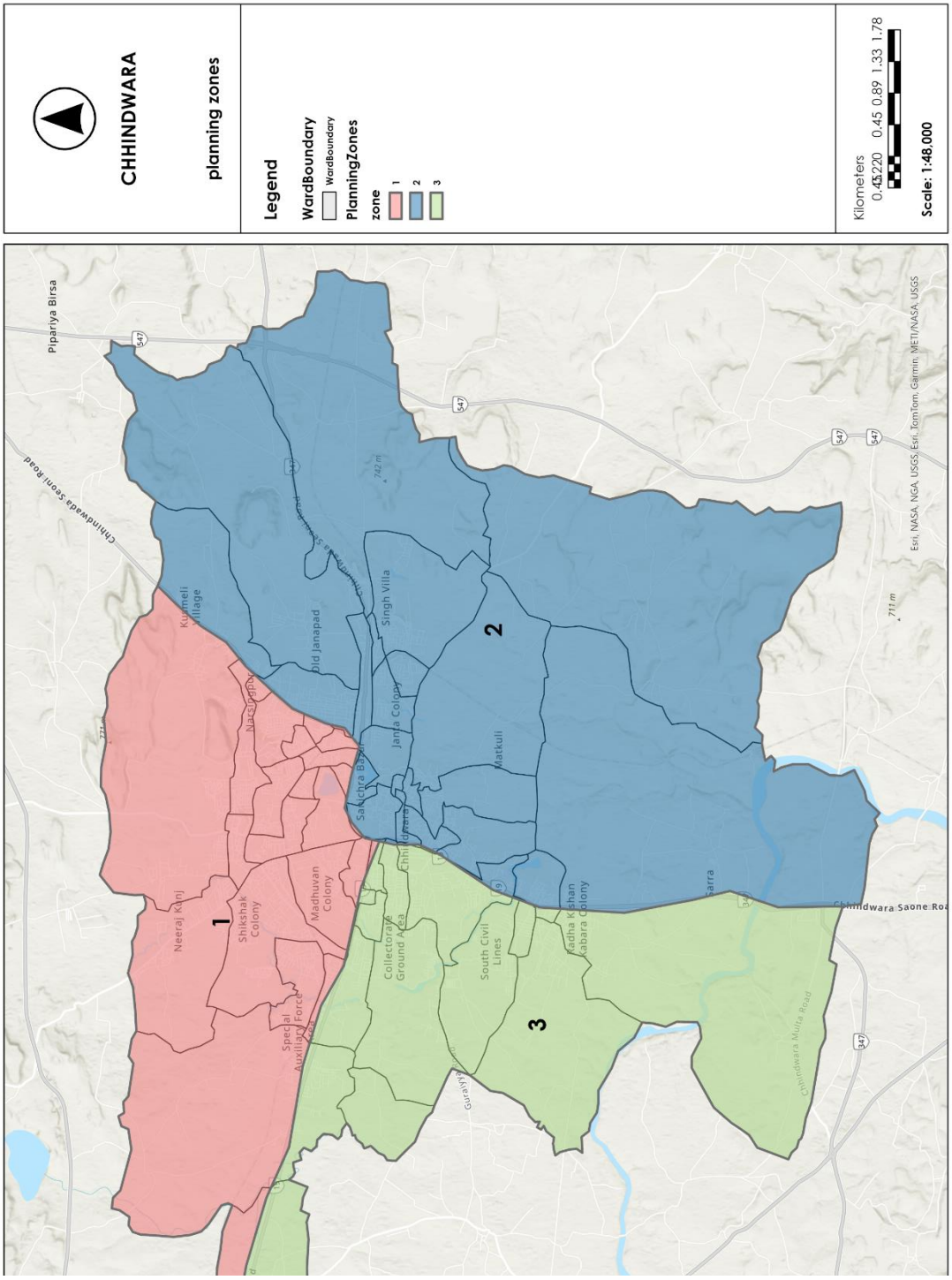


Figure 17 planning zones of chhindwara

1. **Proposed Area for Development**: 1,472.62 ha
2. **Future Reserved Area** : 2,423.38 ha

These three zones have been developed not only to guide phased urban expansion but also to promote **infrastructure prioritization**, **land pooling**, and **balanced economic distribution**. By integrating existing urban infrastructure with strategic reserves for future use, Chhindwara's planning model creates a flexible yet structured framework for accommodating its long-term growth.

Investment Unit	Total Area (ha)	Proposed Area (ha)	Future Use Reserved (ha)
Unit 1	4357.00	1539.93	2817.07
Unit 2	4126.50	1387.45	2739.05
Unit 3	3896.00	1472.62	2423.38

4.3 Population

Population Growth and Demographic Shifts

Chhindwara has experienced significant population growth over the past few decades, with rapid urbanization contributing to increasing population concentration within the municipal limits. According to the records, the **population in 1991 was 96,858**, which rose to **1,16,380 by 2001**, marking a **decadal growth rate of 20.15%**. However, the most significant surge occurred during the **2001–2011 decade**, when the population jumped to **2,15,843**, reflecting a **remarkable growth rate of 44.81%**.

This sharp increase can be attributed to the **expansion of urban jurisdiction**, migration from rural areas, and intensified economic activity in and around the core city. It also highlights a period of transformation in the city's urban form, transitioning from a medium-sized town to a more dynamic urban center.

Population projections made using the **Geometric Increase Method** estimate a continued rise, reaching **3,10,814 in 2021**, and are expected to further climb to **4,47,572 by 2031** and **5,02,275 by 2035**. The total number of **municipal wards remains at 48**, reflecting the administrative division of the growing urban area.

Demographically, the population comprises **55% General Castes**, **30% Scheduled Castes**, and **15% Scheduled Tribes**, indicating a socially diverse urban population. However, spatial analysis reveals **significant differences in population density** between

the **older core areas** and the **newer peripheral wards**, as shown in the thematic density map. The older wards in the central part of the city have high population density, while outer wards remain relatively underpopulated.

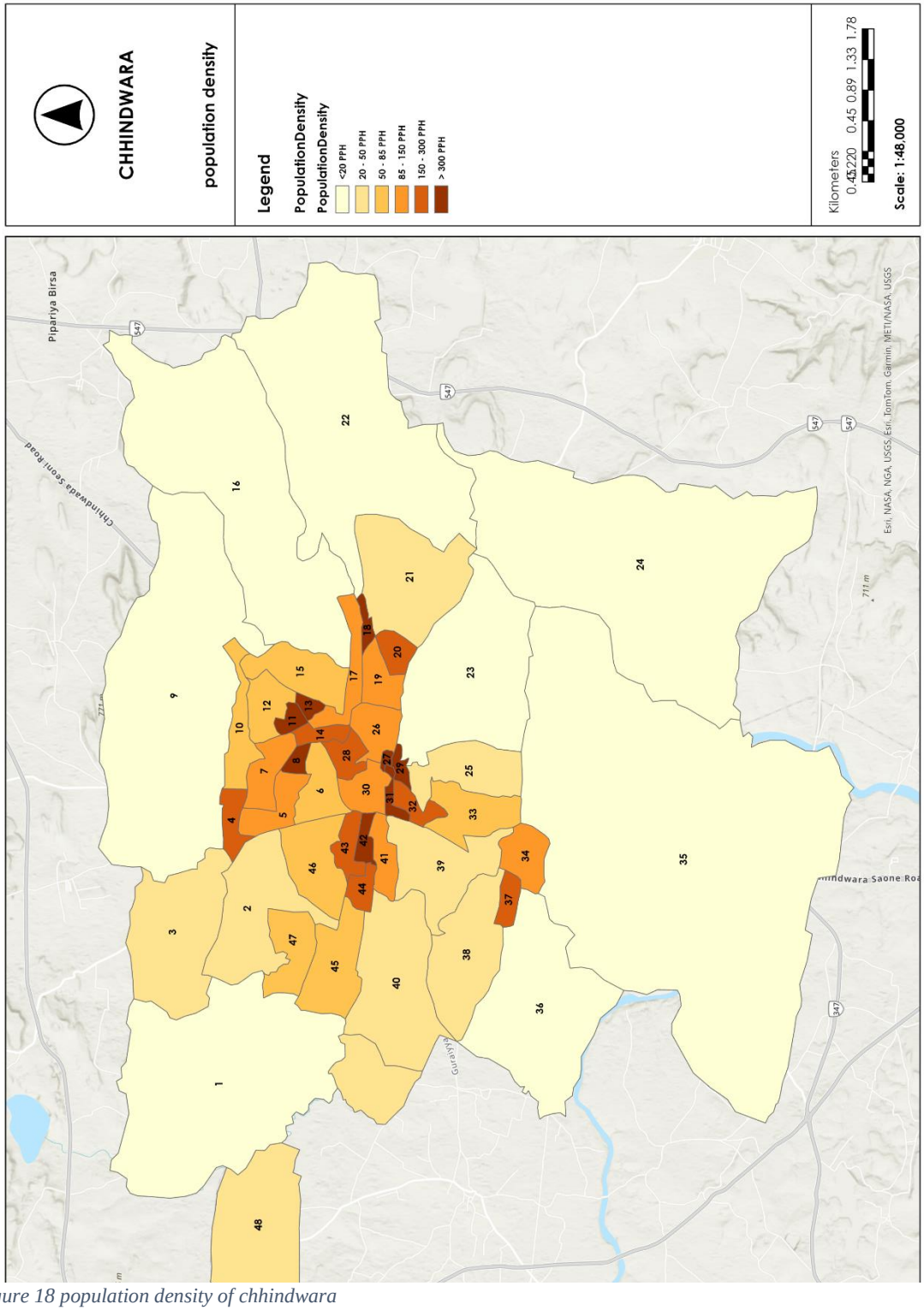
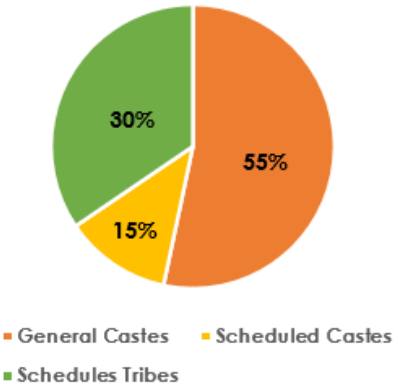


Figure 18 population density of chhindwara

Year	Population	Decadal Growth Rate (%)
1991	96,858	28.83
2001	1,16,380	20.15
2011	2,15,843	44.81
2021	*3,10,814*	*30.5*
2031	*4,47,572*	*30.5*
2035	*5,02,275*	-

- Chhindwara DP Report 2035



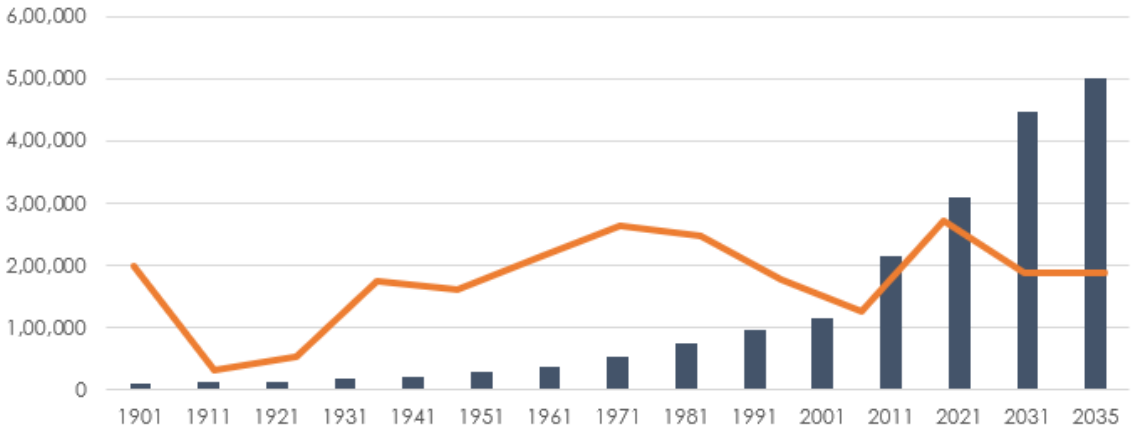


Table 3 decadal population growth and composition

4.4 Urban Sprawl

Urban Sprawl Trends

Chhindwara's physical growth pattern reveals a clear timeline of **urban sprawl**, influenced by historical core development and subsequent peripheral expansion along transport corridors.

- Up to **2004**, the city's **built-up area (yellow)** covered approximately **1116 hectares**, largely confined to the **central core**, which comprises the historic urban fabric and administrative zones. This reflects the traditional model of compact city growth focused around civic and economic hubs.
- Between **2004 and 2011**, an additional **333 hectares (red)** of urban expansion took place. This phase was marked by **corridor-driven growth**, predominantly extending toward **Nagpur, Parasia, and Seoni**. The growth was **linear and infrastructure-led**, following major roads and highways, particularly along NH routes and rail-linked zones.
- From **2011 to 2020**, the city witnessed another **331 hectares (green)** of expansion.

Unlike the earlier linear patterns, this phase shows a **scattered and decentralized sprawl**, primarily into **rural peripheries**. This indicates a **shift toward fringe development**, with informal growth putting pressure on peripheral lands and

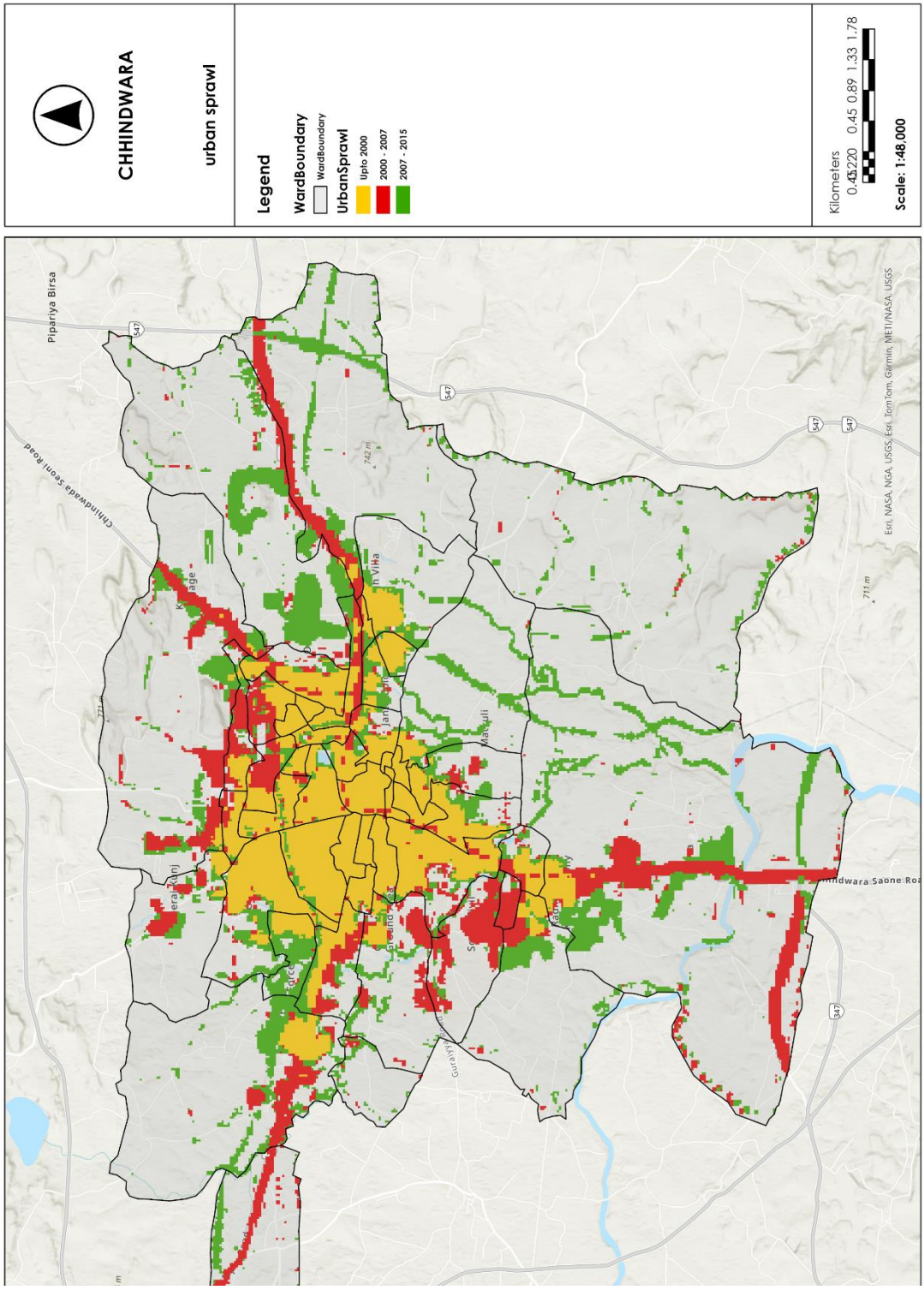


Figure 19 urban sprawl of chhindwara

signalling the emergence of **urban functions beyond the core city**.

This evolving pattern of **decentralization**, when overlaid with density and land use data, reveals both opportunities and challenges. While it reflects growing land demand and functional diversification, it also underscores the need for **guided and serviced urban extensions** to avoid unregulated expansion and infrastructure stress.

4.5 Existing Landuse

Existing Land-Use Profile (2023)

The existing land-use scenario in Chhindwara, as of 2023, reflects a combination of **organic expansion**, **zonal disparities**, and **corridor-driven development**. A detailed observation of the land-use map highlights the following patterns:

- **Residential areas** dominate the built-up zones, extending primarily from the **central core** outward along major roads. This distribution reflects both **planned subdivisions** and **organic sprawl**, especially in the older city center and recently absorbed peri-urban pockets.
- **Commercial zones** are predominantly concentrated in the **city center** and along key arterial roads. These show characteristics of **linear market development**, indicating that commercial activities are aligned with vehicular movement and accessibility.
- **Public/semi-public (PSP) zones** are widely dispersed, often clustering near **institutional hubs**, schools, hospitals, and administrative complexes. This suggests a partially decentralized model for civic infrastructure.
- **Industrial use** is concentrated in the **southern and peripheral areas**, likely to minimize land-use conflicts with residential settlements. These zones are more functional than spatially planned, with irregular boundaries and low density.
- **Green areas and parks** are relatively limited and mostly situated toward the **urban fringe**, with very little green open space available in dense core areas. This reflects the low priority historically given to recreational zoning in the city's inner wards.
- The **northern and eastern regions** still consist largely of **vacant or agricultural land**, signaling substantial **future expansion potential**. These regions are yet to

be integrated fully into the urban economy and infrastructure grid.

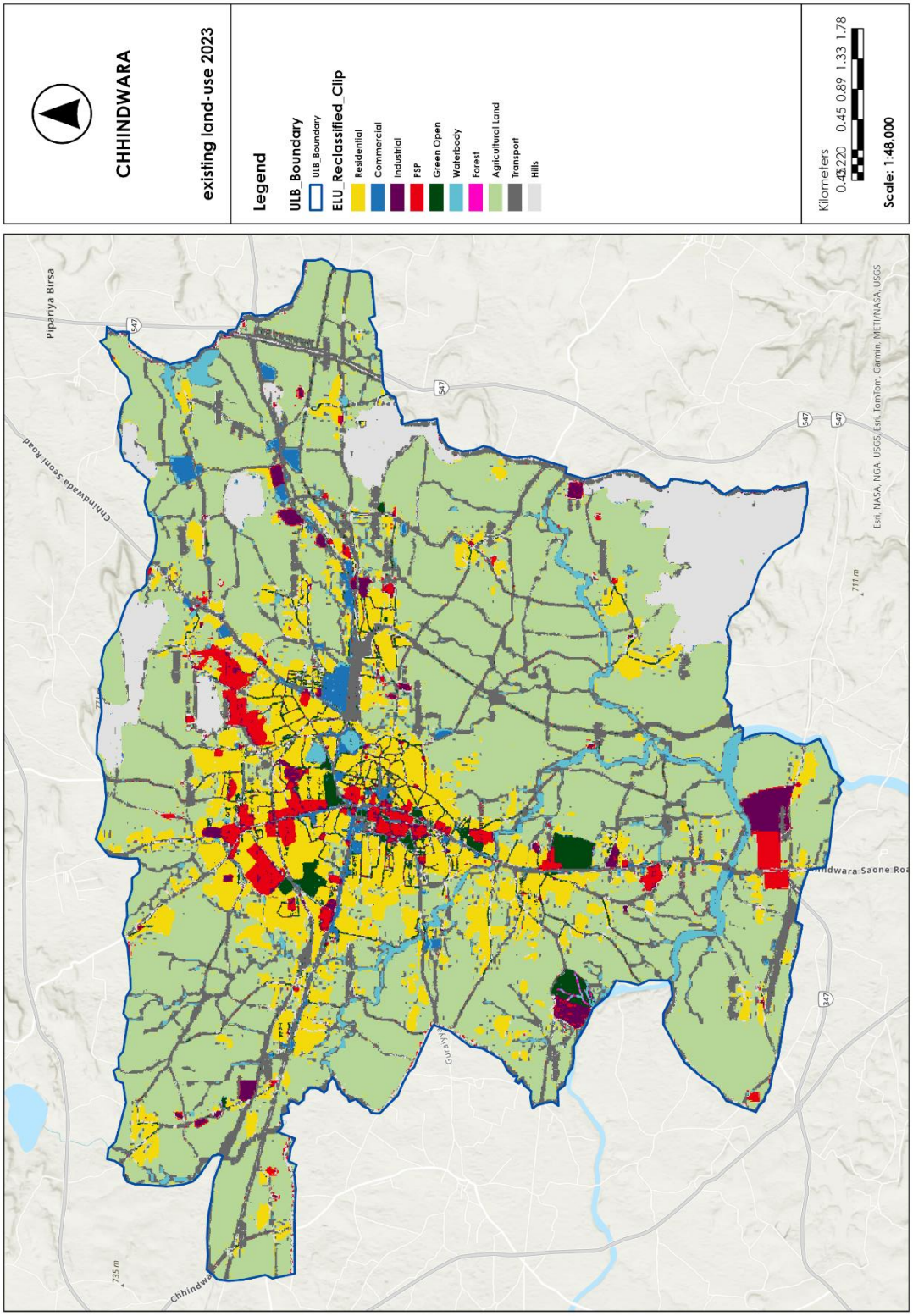


Figure 20 existing land use 2023 of chhindwara

4.6 Proposed Landuse 2035

The proposed land-use strategy under the Chhindwara Development Plan 2035 attempts to address the deficiencies in the current structure by introducing a **more balanced and functionally zoned urban fabric**.

- **Residential zones** remain the dominant category, but their spatial footprint becomes more **evenly distributed**, forming a **broad suburban ring** around the central core. This reflects a **planned suburbanization model**, aimed at decongesting the core city and promoting liveable peripheral neighborhoods.
- **Public and semi-public zones** are **well-integrated** with residential areas, enhancing access to **essential public services** like schools, hospitals, and civic centers. This reallocation strengthens the role of social infrastructure in urban livability.
- **Industrial areas** are strategically shifted and expanded along the **eastern and southern edges**, especially in underutilized land in the north and southeast. This transition not only addresses land-use conflicts but also aims to **boost local employment** and support the city's **economic base**.
- **Green and recreational spaces** show significant improvement, with **systematic allocation** across the map, particularly on the **southern and western fringes**. This change reflects an environmental focus, intending to make Chhindwara's urban growth more sustainable and resilient.
- The **transportation network** is refined in the proposal, with new corridors cutting across emerging zones and integrating with regional highways. These upgrades are crucial to supporting **future population distribution** and economic flows.
- As a major improvement, the plan introduces **larger and well-zoned industrial areas**, particularly in areas that were previously underdeveloped. These zones are intended to **diversify the economic geography** of the city and reduce dependency on the central core for jobs and services.

Land Use Distribution Comparison

The bar chart at the bottom visually compares the proportional changes in land-use categories from **2011 and 2023**, with the **URDPFI Guidelines** and **Proposed 2035 targets** as reference points. Key takeaways include:

- **Residential land share** remains dominant, projected at around **48% by 2035**,

close to URDPFI norms.

- **Industrial zones** rise significantly from just over **2.7% in 2023** to **9.6% by 2035**, indicating a deliberate push for economic diversification.
- **Public and semi-public zones** are expanded to over **5%**, aligning with service distribution goals.
- **Recreational land** sees one of the most dramatic increases, from a negligible **0.06% in 2023** to **4.66% in 2035**, approaching the **6% benchmark** suggested by planning guidelines.

Overall, the **proposed land-use plan strengthens spatial logic**, introduces **zoning balance**, and aligns land allocation with **future demographic and economic aspirations** for Chhindwara.

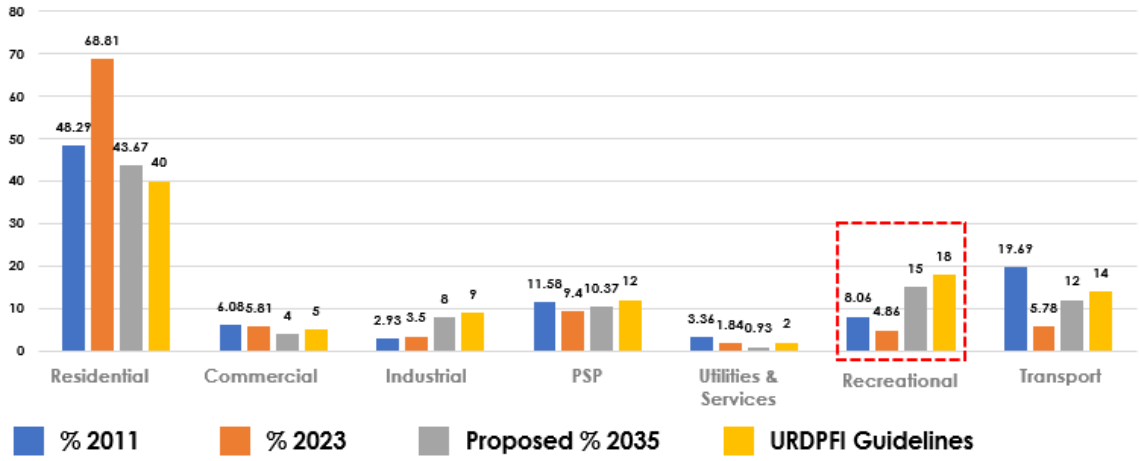


Figure 21 landuse areas ELU PLU and URDPFI

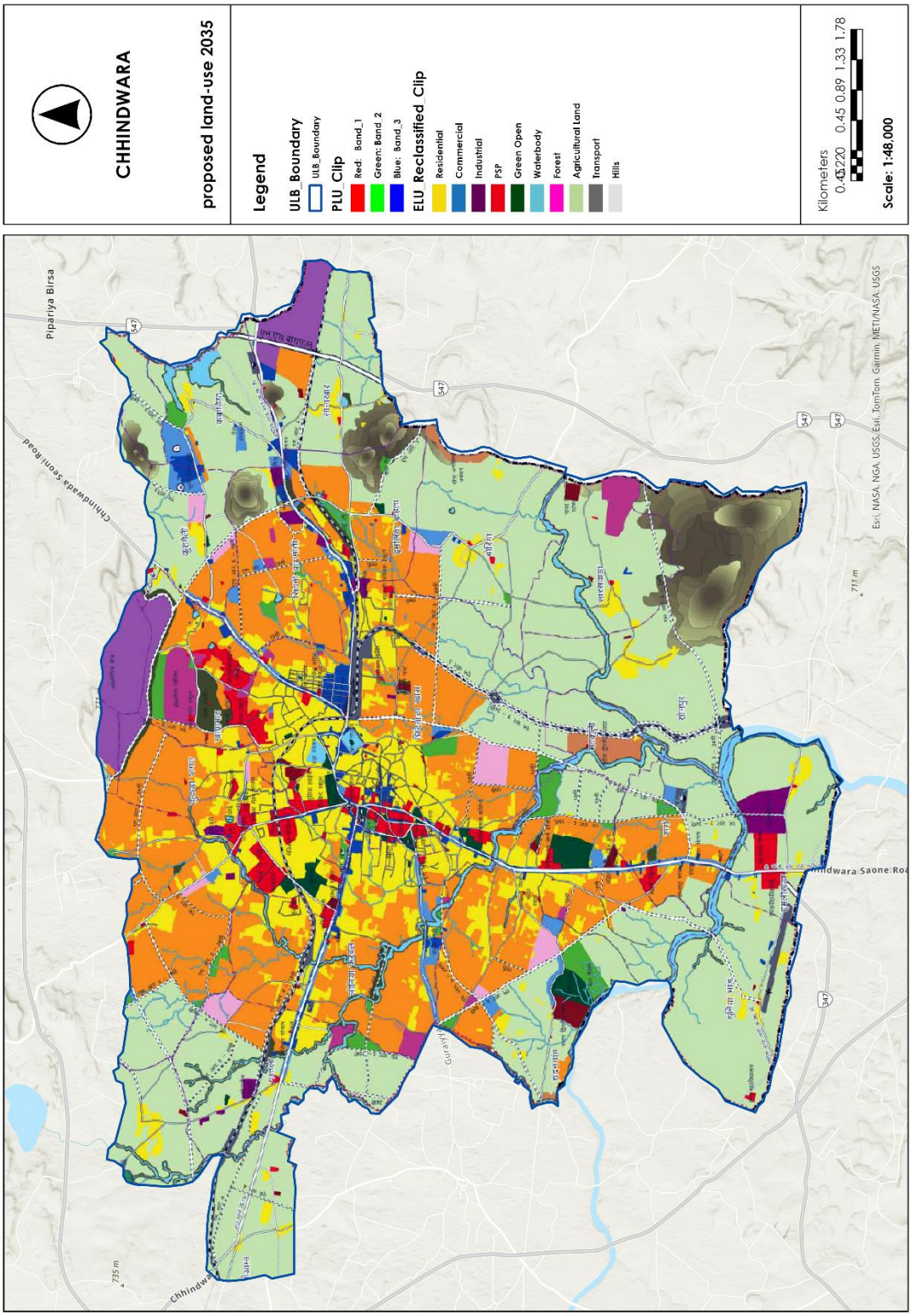


Figure 22 proposed land use of chhindwara

4.7 Economic Profile

Chhindwara's economy is characterized by a **diverse blend of agricultural activity, industrial presence, forest-based livelihoods, and tourism potential**. The district's economic development is supported by both **traditional rural sectors** and **modern urban industries**, making it a unique and multi-dimensional economy in the region.

Agricultural Economy

Agriculture continues to serve as a **foundational sector** in Chhindwara's economy. The region produces a wide variety of **major crops** that contribute significantly to local food supply chains and rural employment. In addition to staple crops, **horticulture** is gaining importance, especially in peri-urban areas, owing to increasing demand and favorable agro-climatic conditions. These activities not only support food security but also lay the base for **agro-processing and value addition** in the district.

Year	GDDP at Constant 2011-12 Prices (Rs Lakhs)
2011–12	11,24,422
2012–13	12,62,367
2013–14	12,93,209
2014–15	13,80,370
2015–16	16,07,489
2016–17	16,36,799
2017–18	15,72,887

- Report by Department of Planning, Economics & Statistics

Table 5 GDP of chhindwara

Industrial Development

Chhindwara hosts a few notable industrial units that anchor its urban economy. Among them is the **Hindustan Unilever Limited (HUL) facility**, which plays a critical role in employment and industrial output. Another key player is the **Raymond Textile Plant**, which contributes to both manufacturing and regional branding. These industries are backed by the emerging sector of **spices and agro-processing**, which leverages the local agricultural surplus and supports small-scale manufacturing.

Despite these developments, the industrial landscape remains **modest and scattered**,

suggesting significant room for **industrial expansion, clustering, and formal zoning**. Strengthening linkages between agricultural production and agro-processing will be vital to enhance local value chains.

Forest-Based Economy and Herbal Trade

Chhindwara has long benefited from its **forest-based economy**, particularly in tribal and rural areas. The district has notable potential in the **herbal medicine economy**, driven by **non-timber forest produce (NTFP)** and traditional knowledge systems. A growing number of **Ayurvedic processing units** are being considered or piloted in the region, reflecting opportunities for **ethnomedicinal commercialization**. This sector also aligns with national priorities on indigenous medicine, self-reliant health industries, and sustainable forest use.

Proper institutional support and formalization of herbal trade could enable Chhindwara to become a **regional hub for Ayurvedic and forest-based medicinal products**.

Tourism and Cultural Assets

Tourism plays a supportive but underutilized role in Chhindwara's economy. The **Pench Tiger Reserve**, a significant natural asset located nearby, holds high potential for **eco-tourism and wildlife-based recreation**. Alongside this, **cultural tourism** rooted in tribal traditions, local festivals, and natural heritage can be developed further to attract visitors and generate supplementary income for local communities.

Promoting **integrated tourism circuits** that combine wildlife, herbal eco-tourism, and culture can help in positioning Chhindwara as a **multi-asset tourism district** in Madhya Pradesh.

Economic Growth Trends: GDDP and Per Capita Income

The **Gross District Domestic Product (GDDP)** at constant 2011–12 prices indicates a phase of **consistent growth** from 2011–12 to 2016–17. During this period, GDDP rose from **₹11.24 lakh to ₹16.36 lakh**, reflecting enhanced economic activity across sectors. However, a decline was observed in **2017–18**, with GDDP dropping to **₹15.72 lakh**, suggesting a **slowdown in key sectors**, potentially due to **agricultural distress or stagnation in industrial production**.

Similarly, **per capita income** showed a steady increase from **₹48,321 in 2011–12 to**

₹64,635 in 2016–17, demonstrating rising personal income levels and improved living standards. In 2017–18, however, per capita income slightly fell to **₹61,513**, indicating either a growth lag or inflationary effects offsetting income gains.

Year	Per Capita Income at Constant (2011–12) Prices (Rs)
2011–12	48,321
2012–13	52,884
2013–14	53,313
2014–15	55,943
2015–16	64,200
2016–17	64,635
2017–18	61,513

- Report by Department of Planning, Economics & Statistics

Table 7 per capita income

These patterns underscore the need for **economic diversification**, **sectoral integration**, and **targeted interventions** in underperforming sectors to ensure sustainable and inclusive growth for the district.

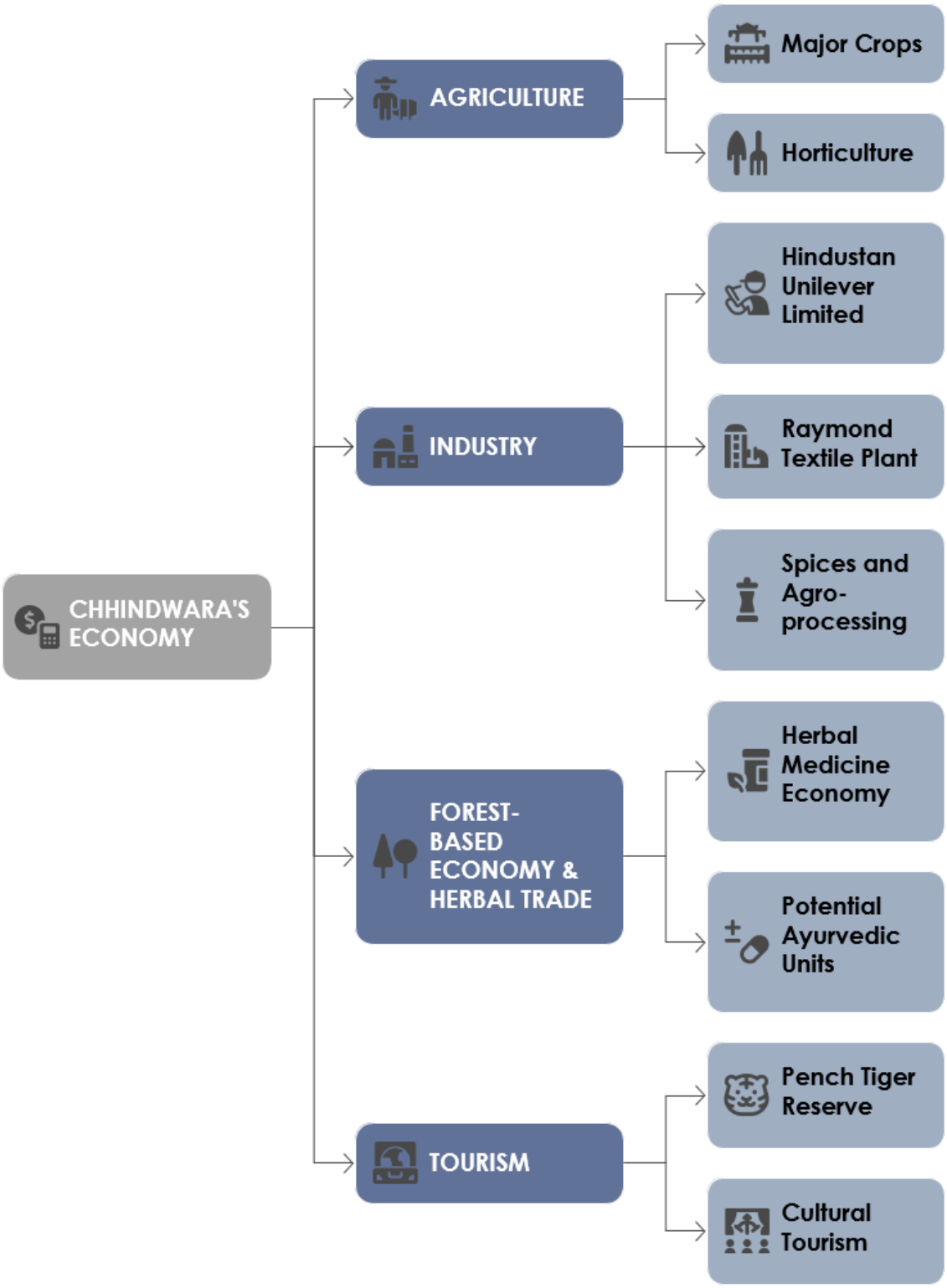


Figure 23 flowchart showing chhindwara's economic bases

Agriculture and Primary Sector Dynamics

Agriculture remains the backbone of Chhindwara's economy, serving as the **primary occupation** for a large portion of the rural population. Key crops include **wheat, rice, soyabean, maize, pulses, and oilseeds**. Additionally, **horticulture and floriculture**—particularly the cultivation of **oranges and guavas**—are gaining prominence, especially in peri-urban and tribal regions.

According to workforce statistics, the **primary sector** employs a total of **4,570 workers**, with **agriculture and agricultural laborers accounting for over 70%** of this number. The sector exhibits a worker-to-population ratio of **21 workers per 1,000 people**, reflecting moderate engagement levels in rural zones.

Industrial Activity and MSME Sector

Chhindwara hosts a growing industrial base anchored by **Hindustan Unilever Limited (HUL)** and the **Raymond Textile Plant**, both of which are large-scale employers. In addition, the city has witnessed the rise of **spices and agro-processing units**, facilitated by agricultural surplus and growing local demand. Industrial estates in **Kuddam and Chhindwara Industrial Park** provide the spatial framework for Micro, Small, and Medium Enterprises (MSMEs) to thrive.

According to the District Industries Centre (2020), the district is home to a **diverse range of MSMEs**, with the **agro-based sector leading** in both investment and employment. Specifically:

- **82 agro-based units** have invested over **₹41.63 crore**, employing **1,162 people**.
- Other active segments include **metal-based fabrication**, **chemical units**, **woodworks**, and **engineering services**.
- In total, **1,051 units across sectors** employ **8,390 people**, indicating a **vibrant small-scale industrial ecosystem**.

In the **secondary sector**, employment stands at **23,705 workers**, with **household industries** alone engaging **13,160 workers**—over **55%** of the secondary sector. This points to the dominance of **home-based and small-scale industries** in shaping the local production base.

NIC code no.	Type of Industry	Number of Units	Investment (Rs. in Lakhs)	Employment
20	Agro based	82	4,163.39	1,162
25	Jute & jute based	03	1.82	25
26	Ready-made garments & embroidery	02	1.21	15
27	Wood/wooden based furniture	51	68.60	242
28	Paper & paper products	09	167.61	97
29	Leather based	02	0.01	02
31	Chemical/Chemical based	08	418.44	146
30	Rubber, Plastic & petro based	09	987.18	132
32	Mineral based	22	162.61	97
33	Metal based (Steel Fabrication)	62	295.28	756
35	Engineering units	05	802.00	79
97	Repairing & servicing	23	49.53	85
01	Others	325	483.94	884

Table 9 industrial division

Herbal Economy and Forest-Based Potential

Surrounded by the **forested terrain of the Satpura range**, Chhindwara is rich in **Non-Timber Forest Products (NTFPs)** such as **tendu leaves, bamboo, mahua, harra, baheda, and amla**. These natural resources fuel a **strong informal herbal medicine economy**, which, though currently unregulated, holds potential for **formalization and industrial scaling**.

If supported with institutional frameworks, Chhindwara could develop a **niche Ayurvedic and ethnomedicinal processing industry**, leveraging both **tribal knowledge systems** and **market demand for plant-based wellness products**.

Tertiary Sector and Urban Services

The **tertiary sector** forms the largest component of workforce distribution, employing **35,580 individuals**, which is **55.7% of the total workforce**. This includes:

- **Trade & Commerce**: 11,184 workers
- **Transport & Communication**: 4,403 workers
- **Service Sector** (education, health, finance): 19,993 workers

The high number of workers in services indicates the city's **gradual urban transformation**, with growing dependency on **tertiary jobs for income generation**.

Sector-Wise Contribution to GDDP

Analysis of **Gross District Domestic Product (GDDP)** data shows clear trends of **sectoral shifts** over time:

- The **primary sector**, though dominant historically, **declined from ₹8,06,248 lakh in 2016–17 to ₹6,96,531 lakh in 2017–18**, suggesting vulnerability to climate and price fluctuations.
- The **secondary sector** remained relatively stable but modest, peaking at ₹2,76,279 lakh.
- The **tertiary sector** demonstrated consistent growth, reaching ₹4,84,180 lakh by 2017–18, and is now the **leading contributor to the district's GDP**.

This trajectory confirms a **structural shift in Chhindwara's economy** from agriculture to services, accompanied by emerging industrial activity and latent potential in the herbal sector.

S. No.	Category / Sector	No. of Workers	Workers per 1000 Population	% of Sector Workers	Workers per 1000 Population (Sub-sector)
1	Primary Sector				
(a)	Agriculture	2,126	33.13	46.52%	10
(b)	Agricultural Labourers	1,119	17.44	24.48%	6
(c)	Mining	1,325	20.66	29.00%	5
	Total	**4,570**	**71.23**	**100.00%**	**21**
2	Secondary Sector				
(a)	Household Industries	13,160	205.12	55.52%	59
(b)	Manufacturing	7,675	119.63	32.37%	34
(c)	Construction	2,870	44.74	12.11%	13
	Total	**23,705**	**369.49**	**100.00%**	**106**
3	Tertiary Sector				
(a)	Trade & Commerce	11,184	174.32	31.43%	50
(b)	Transport, Storage & Communication	4,403	68.64	12.37%	19
(c)	Services	19,993	311.63	56.20%	91
	Total	**35,580**	**554.59**	**100.00%**	**160**
	Grand Total	**63,855**	**1000.00**	**100.00%**	**287**

- Report by Department of Planning, Economics & Statistics, 2011

Table 11 sector based contribution of workforce

Table 13 sector based contribution

S.N.	Sector	2011–12	2012–13	2013–14	2014–15	2015–16	2016–17	2017–18
1	Primary	5,54,443	6,61,601	6,45,709	7,03,343	8,26,541	8,06,248	6,96,531
2	Secondary	2,04,561	1,98,533	2,05,925	2,12,086	2,47,948	2,57,863	2,76,279
3	Tertiary	3,23,112	3,53,829	3,71,425	3,91,942	4,22,296	4,57,259	4,84,180
	Total GDVA	**10,82,115**	**12,13,962**	**12,23,059**	**13,07,371**	**14,96,785**	**15,21,370**	**14,56,991**

Summary: Employment Landscape and Self-Sufficiency

The Chhindwara planning area currently supports a **total workforce of 63,855 people**, accounting for **28.6% of the population**. The overall employment structure is spread across agriculture, industry, and services, with a noticeable **concentration in household industries and services**.

This distribution suggests that **self-sufficiency in employment** remains a critical concern. While **urban and industrial jobs are rising**, a substantial portion of the population continues to depend on **low-income or informal sectors**. Addressing this through skill development, economic diversification, and formalization of sectors such as **Ayurveda, MSMEs, and eco-tourism** will be key to Chhindwara's economic resilience.

4.8 Ethno-Medicinal Market of Chhindwara

Chhindwara's rich ecological landscape and tribal heritage have created a unique opportunity for the development of an **ethno-medicinal economy**, deeply rooted in **indigenous knowledge systems** and sustainable forest use.

Tribal Knowledge and Resource Base

The **tribal communities** of Chhindwara, primarily **Bhariya and Gond**, have lived in close association with the forests for generations. These communities possess a deep understanding of **forest-based medicinal resources**, developed through traditional practices passed down over centuries. Their expertise includes identifying, collecting, and processing various **non-timber forest products (NTFPs)** for health and wellness applications.

The district's forests provide a **rich repository of plant-based resources**, with clusters of herbal usage identified in areas such as **Tamia, Harrai, Ratool, Chhind, and Batkakhapa** (as shown in the map). These areas act as localized hubs for **ethno-medicinal harvesting and informal trade**.

Usage Patterns and Herbal Formulations

Field studies and institutional research—such as those conducted by **JNKVV Agriculture College, Chhindwara**—highlight the widespread use of **herbal formulations** in tribal medical practice. These include:

- **Powders**
- **Pastes**
- **Decoctions**
- **Oils**
- **Raw and Roasted Roots**

The bar graph depicts the number of plant species used per type of ailment and formulation, indicating a broad range of applications for digestive, respiratory, and muscular conditions, among others.

Another chart details the **parts of the plant** most frequently used in medicinal recipes, with **leaves, fruits, roots, and stems** being the dominant categories. This reflects a sustainable harvesting practice wherein plants are used without necessarily uprooting them, aligning with **ecological conservation principles**.

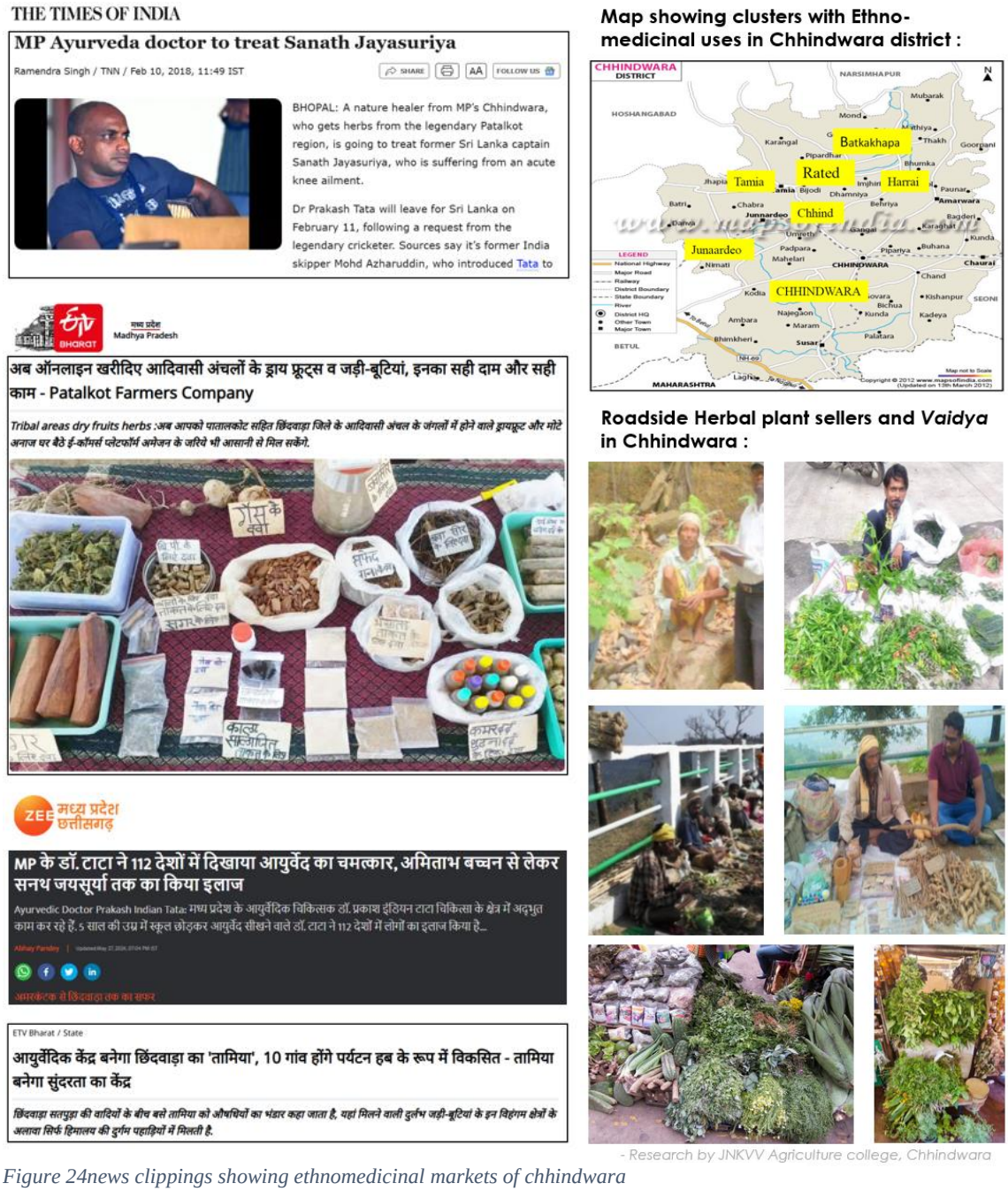

THE TIMES OF INDIA
MP Ayurveda doctor to treat Sanath Jayasuriya
Ramendra Singh / TNN / Feb 10, 2018, 11:49 IST
BHOPAL: A nature healer from MP's Chhindwara, who gets herbs from the legendary Patalkot region, is going to treat former Sri Lanka captain Sanath Jayasuriya, who is suffering from an acute knee ailment.
Dr Prakash Tata will leave for Sri Lanka on February 11, following a request from the legendary cricketer. Sources say it's former India skipper Mohd Azharuddin, who introduced Tata to
ETV BHARAT
मध्य प्रदेश
Madhya Pradesh
अब ऑनलाइन खरीदिए आदिवासी अंचलों के ड्राय फ्रूट्स व जड़ी-बूटियां, इनका सही दाम और सही काम - Patalkot Farmers Company
Tribal areas dry fruits herbs :अब आपको पातालकोट सहित छिंदवाड़ा जिले के आदिवासी अंचल के जंगलों में होने वाले ड्रायफ्रूट और मोटे अनाज घर बैठे ई-कॉमर्स प्लेटफॉर्म अमेजन के जरिये भी आसानी से मिल सकेंगे.
ZEE मध्य प्रदेश छत्तीसगढ़
MP के डॉ. टाटा ने 112 देशों में दिखाया आयुर्वेद का चमत्कार, अमिताभ बच्चन से लेकर सनथ जयसूर्या तक का किया इलाज
Ayurvedic Doctor Prakash Indian Tata: मध्य प्रदेश के आयुर्वेदिक चिकित्सक डॉ. प्रकाश इंडियन टाटा चिकित्सा के क्षेत्र में अद्भुत काम कर रहे हैं. 5 साल की उम्र में स्कूल छोड़कर आयुर्वेद सीखने वाले डॉ. टाटा ने 112 देशों में लोगों का इलाज किया है...
ETV Bharat / State
आयुर्वेदिक केंद्र बनेगा छिंदवाड़ा का 'तामिया', 10 गांव होंगे पर्यटन हब के रूप में विकसित - तामिया बनेगा सुंदरता का केंद्र
छिंदवाड़ा सतपुड़ा की वादियों के बीच बसे तामिया को औषधियों का भंडार कहा जाता है, यहां मिलने वाली दुर्लभ जड़ी-बूटियां के इन विहंगम क्षेत्रों के अलावा सिर्फ हिमालय की दुर्गम पहाड़ियों में मिलती है.
Map showing clusters with Ethno-medicinal uses in Chhindwara district :
CHHINDWARA DISTRICT
Batkakhapa
Rated
Tamia
Harrai
Chhind
Junnardeo
CHHINDWARA
MAHARASHTRA
Roadside Herbal plant sellers and Vaidya in Chhindwara :
- Research by JNKVV Agriculture college, Chhindwara

Figure 24news clippings showing ethnomedicinal markets of chhindwara

Local Trade and Informal Economy

Roadside images from across the district demonstrate the presence of **informal Vaidya networks**—traditional healers and herbalists—who operate stalls at village markets and roadside clusters. These individuals serve as the **primary link** between the forest resource base and the local population in need of remedies.

However, despite the rich cultural and ecological foundation, the **commercial infrastructure** remains severely underdeveloped. Currently, **Chhindwara has only one registered trader** in the **herbal raw drug mandi**, suggesting the absence of formalized

markets and structured supply chains. This gap limits the district's ability to capitalize on its **natural medicinal wealth**.

Policy Potential and Economic Opportunity

Madhya Pradesh is one of the **leading states in India for licensed herbal units**, boasting **625 recognized entities**. Yet, Chhindwara has not fully integrated into this formal ecosystem. There exists **immense potential** for:

- Establishing **Ayurvedic and herbal processing clusters**
- Creating a **medicinal plant industrial hub**
- Building **mandis, warehouses, and quality testing labs** for medicinal products

These interventions could transform an informal livelihood economy into a **high-value, export-oriented herbal trade ecosystem**, while empowering tribal communities through **organized income channels** and **value-added processing**.

Summary

The underutilization of Chhindwara's herbal knowledge and resources highlights a **critical opportunity for formalization and expansion**. If supported by appropriate planning, infrastructure, and market linkages, Chhindwara can emerge as a **regional leader in the Ayurvedic and herbal sector**, contributing significantly to both local livelihoods and India's wellness economy.

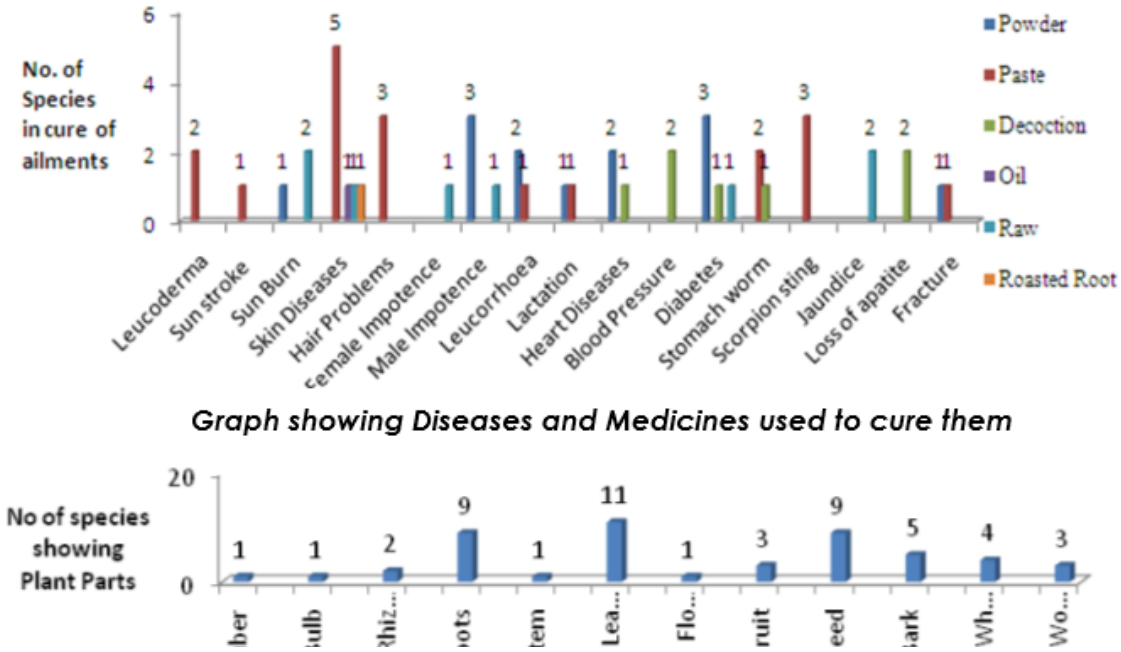


Figure 26 graphs showing various diseases cured and plants used for it

Licensed Herbal Units in India: Madhya Pradesh's Strategic Position

India has seen a remarkable expansion in the registration of **licensed herbal manufacturing units**, reflecting the growing policy interest and commercial potential of **traditional medicine systems** such as **Ayurveda, Unani, Siddha, and Homeopathy (AYUSH)**. The data from the **Ministry of AYUSH, Government of India** shows that

State	Number of Licenced Herbal Units					
	Ayurveda	Unani	Siddha	Tibetan	Homeopathic	Total
Andaman & Nicobar	-	-	-	-	-	-
Andhra Pradesh	473	106	-	-	31	610
Arunachal Pradesh	-	-	-	-	-	-
Assam	52	-	-	-	1	53
Bihar	214	27	-	-	40	281
Chandigarh	1	-	-	-	-	1
Chhattisgarh	31	-	-	-	-	31
Dadra & Nagar Haveli	5	-	-	-	-	5
Daman & Diu	10	-	-	-	-	10
Delhi	43	12	-	-	8	63
Goa	7	-	-	-	-	7
Gujarat	480	-	-	-	15	495
Haryana	274	3	-	-	23	300
Himachal Pradesh	135	-	-	-	3	138
Jammu & Kashmir	11	2	-	-	2	15
Jharkhand	-	-	-	-	-	-
Karnataka	166	1	-	-	10	177
Kerala	880	1	4	-	20	905
Lakshdeep	-	-	-	-	-	-
Madhya Pradesh	625	-	-	-	8	633
Maharashtra	660	6	-	-	39	705
Manipur	-	-	-	-	-	-
Meghalaya	1	-	-	-	-	1
Mizoram	-	-	-	-	-	-
Nagaland	-	-	-	-	34	34
Odisha	148	-	-	-	12	160
Puducherry	25	10	-	-	6	41
Punjab	284	-	-	-	-	284
Rajasthan	265	3	-	-	-	268
Sikkim	1	-	-	-	-	1
Tamil Nadu	323	10	324	-	5	662
Tripura	-	-	-	-	-	-
Uttarakhand	237	3	-	-	-	240
Uttar Pradesh	1974	237	-	-	36	2247
West Bengal	169	3	-	-	105	277
Total	**7494**	**421**	**328**	**-**	**367**	**8610**

Table 14 no. of licensed herbal units in india

Madhya Pradesh ranks among the top five states in terms of total licensed herbal units.

- **Madhya Pradesh** has a total of **633 licensed herbal units**, of which **625 are Ayurveda-based**.
- This places the state just behind Maharashtra (705 units), and well ahead of others like Kerala (905 units, with a more diverse distribution across systems), Gujarat (506), and Uttar Pradesh (2,357, largely due to Homeopathy).
- The high concentration of licensed Ayurveda units indicates a **strong institutional base and technical workforce** for herbal medicine processing in the state.

This positions **Chhindwara district—rich in forest biodiversity and tribal knowledge—as a prime candidate** for scaling up **licensed herbal industries** and formal medicinal plant-based economic activities.

Sr.No.	Name of Mandi	Number of Traders in the Mandi (Approx.)
1.	Khari Baoli, Delhi	250
2.	MajithMandi, Amritsar (Punjab)	35
3.	Tanakpur (Uttarakhand)	14
4.	Ramnagar (Uttarakhand)	12
5.	Sharanpur (Uttar Pradesh)	08
6.	Kanpur (Uttar Pradesh)	21
7.	Lucknow (Uttar Pradesh)	23
8.	Kannauj (Uttar Pradesh)	09
19.	Chhindwara (Madhya Pradesh)	01
20.	Mumbai (Maharashtra)	250
21.	Chandrapur (Maharashtra)	01
22.	Nagpur (Maharashtra)	07
23.	Amravati (Maharashtra)	02
24.	Koraput (Odisha)	09
25.	Cuttak (Odisha)	03
26.	Patna (Bihar)	04
27.	Ranchi (Jharkhand)	02
28.	Kolkata (West Bengal)	54
29.	Chennai (Tamil Nadu)	40

Table 16 no. of traders and mandies

Mandi Infrastructure and Trade Bottlenecks

However, the economic infrastructure **required to commercialize this potential remains**

significantly underdeveloped, particularly in Chhindwara. According to the **National Medicinal Plants Board (NMPB)**, there are **29 major conventional herbal raw drug mandis** across India, where forest produce and medicinal plants are traded.

Chhindwara does feature in this list (Ranked **19th**), but its presence is minimal:

- The **Chhindwara herbal raw drug mandi** has only **one registered trader**, the lowest among all mandis listed.
- In contrast, leading mandis like **Khari Baoli (Delhi)** host **250 traders**, and even tier-two locations like **MajithMandi (Punjab)** and **Lucknow (U.P.)** accommodate over **20 traders** each.

This data exposes a critical **gap between resource availability and trade facilitation**. While the **biological wealth** and **community knowledge** exist in abundance, the **market infrastructure** to support harvesting, aggregation, quality certification, pricing, and export is severely lacking in Chhindwara.

Unlocking Potential Through Institutional Support

The contrast between high herbal unit licensing in Madhya Pradesh and **low mandi functionality in Chhindwara** highlights an urgent need for **institutional convergence**. Some strategic steps to address this imbalance include:

- **Upgrading the Chhindwara herbal mandi** with more trader licenses, storage facilities, and pricing transparency mechanisms.
- Establishing **processing units near raw material zones** to reduce post-harvest loss and ensure value addition.
- Linking tribal collectors with formal cooperatives and government-backed **Van Dhan Vikas Kendras** for technical support and market integration.
- Promoting **public-private partnerships (PPPs)** in building infrastructure such as **drying chambers, sorting sheds, cold chains, and testing labs**.

Such initiatives could transform the herbal trade in Chhindwara from **an informal livelihood-based sector into a structured agro-industrial economy**, bringing both economic and environmental sustainability.

Chapter – 5

Literature Review

5.1 Literature Summary

1. Urban Land Taxes and Land Planning

This paper explores the influence of land-based fiscal tools on urban growth patterns. It highlights that **land taxation significantly affects land use and city expansion** by controlling how land is supplied and utilized. Tools such as **betterment levies and improvement charges** are emphasized as effective mechanisms for financing urban infrastructure and encouraging cities to grow in a more planned manner. The study also illustrates international examples where well-structured taxation frameworks have supported sustainable urban development. Importantly, **efficient tax policies** are found to reduce speculative hoarding of land, making urban areas more accessible for development.

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2. Town Planning Schemes and Land Readjustment

The literature on TPS and LR emphasizes their strategic value in managing urban expansion. It establishes that TPS is essential for **coordinated infrastructure delivery** while also enabling **equitable redistribution of land**. Land Readjustment, in particular, is shown to mitigate the challenge of fragmented and irregular land parcels, making development more organized. The paper underlines that for TPS to succeed, **legal authorization, administrative backing, and public participation** are critical. Comparative insights also position **Gujarat's TPS model** as a replicable best practice, with its clear framework and emphasis on **infrastructure-first planning**.

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3. Land Acquisition Vs. Land Pooling

This paper compares two land assembly approaches in urban development—land acquisition and land pooling. The findings show that **land pooling is a more socially acceptable, efficient, and equitable mechanism** than acquisition, which often leads to community resistance due to displacement concerns. Gujarat and Andhra Pradesh are cited for their innovative pooling models that avoid forced evictions. The study concludes that for land pooling to work effectively, it requires **robust governance systems**,

transparency in compensation, and **community consensus**, all of which enhance stakeholder trust and development feasibility.

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4. State-Led Alternative Mechanisms for Land Acquisition

This study by the **World Resources Institute** assesses six state-led mechanisms such as **TPS, LPS, and PPPs**, highlighting their success in integrating **land planning with service provisioning**. These alternatives are framed as solutions to the limitations of traditional acquisition, especially where rapid urbanization requires agile and inclusive planning tools. The research advocates **land value capture** as a financing strategy, allowing urban authorities to channel land appreciation benefits into infrastructure and service delivery. The paper emphasizes that these mechanisms succeed best when supported by **legal frameworks, fiscal instruments, and strong institutional capacity**.

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5. Manual for Town Planning Schemes

This manual provides a **step-by-step technical guide** for implementing TPS, focusing on procedural clarity, legal grounding, and stakeholder coordination. The Gujarat Real Estate Regulatory Authority (RERA) showcases how the state has used TPS to direct urban growth while ensuring equitable land allocation and public benefit. The manual outlines the role of **land reconstitution**, **value capture**, and **public amenities provisioning**, making it a foundational document for cities considering structured expansion. It calls for continuous legal reform and institutional strengthening to make TPS adaptable across varied urban contexts.

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6. Ethno-Medicinal Uses of Promising Plants in Cure of Ailments in Chhindwara District

This study documents the **ethnomedicinal knowledge of Bhariya and Gond tribes in Chhindwara**, identifying over 50 medicinal plant species used in traditional formulations such as powders, decoctions, and pastes. It reveals that tribal healers rely on orally transmitted knowledge systems, which are at risk of being lost due to modernization and forest degradation. The research stresses the urgency of preserving this **indigenous medical heritage** through documentation, capacity-building, and possible integration with formal health systems. It also hints at economic opportunities through **herbal product processing** and **community-based trade models**.

7. Medicinal Plants in India: An Assessment of Their Demand and Supply

This national-level study by **Goraya and Ved (2017)** evaluates the **supply-demand dynamics of medicinal plants**, showing that India uses around **1,200 commercially viable species**, with **85% sourced from the wild**. The paper raises concerns about **overharvesting**, which threatens biodiversity and long-term availability. With annual demand surpassing **512,000 MT and growing at 10% per annum**, the report underscores the need for regulated harvesting, **cultivation initiatives**, and **policy-backed conservation strategies** to stabilize supply chains and protect forest-based economies.

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8. Flora of Chhindwara District with Special Reference to Ethnobotany

This ethnobotanical research explores the **interdependence between forest ecosystems and indigenous healthcare systems** in Chhindwara. It identifies **36 key plant species** used in traditional medicine for treating common ailments and notes that the knowledge is primarily **inherited orally**. The study flags the risk of cultural erosion due to modernization, as well as the **absence of formal documentation or institutional frameworks** for knowledge preservation. It calls for urgent action to safeguard tribal medicinal practices and proposes that these can be formalized into **sustainable livelihood models** for forest-dwelling communities.

5.2 Inferences

1. **Land Readjustment (LR)** is a key planning strategy that reduces fragmentation and improves urban land management by enabling reorganized and accessible land parcels.
2. **Gujarat's TPS model** is widely cited as a benchmark for successful urban expansion through legal backing, stakeholder involvement, and institutional support.
3. **Land pooling** is recognized as a **cost-effective and socially acceptable** alternative to land acquisition, ensuring participation and minimizing displacement.
4. Studies emphasize that **proper land allocation and active stakeholder involvement** are essential for the success of TPS and LR implementations.
5. **GIS-based cadastral mapping and DEM analysis** enhance the precision and planning logic of land readjustment efforts, supporting spatially accurate ABD proposals.

6. **Chhindwara** hosts rich ethnomedicinal plant diversity, with over **77 species** traditionally used by **Bhariya and Gond tribal communities** for treating various ailments.
7. These tribal practices offer economic potential through **ethnomedicinal and herbal-based industries**, rooted in indigenous healthcare knowledge.
8. However, **overharvesting and modernization** pose serious threats to traditional plant use and tribal knowledge systems.
9. There is a strong need to **formalize and conserve traditional herbal practices** to protect biodiversity and promote sustainable livelihood opportunities.

Sr. No.	Title of the Paper	Author(s) / Source(s)	Objectives of the study	Key Findings
01	**Urban Land Taxes and Land Planning**	Various Authors	• Analyze the impact of land taxes on urban planning and development. • Evaluate how taxation influences land supply and utilization. • Assess the effectiveness of betterment levies in financing urban infrastructure. • Examine international practices of urban land taxation.	• Land taxation affects urban land use and influences city expansion. • Betterment levies and improvement charges can encourage planned urbanization. • Efficient tax policies can mitigate land speculation and hoarding. • International examples show that structured taxation helps in urban development financing.
02	**Town Planning Schemes and Land Readjustment**	Various Authors	• Examine the effectiveness of TPS and land readjustment in managing urban growth. • Analyze how TPS contributes to infrastructure development and service provisioning. • Compare different TPS models implemented in various cities. • Assess the role of government policies in TPS implementation.	• TPS aids in planned development by integrating infrastructure with land use. • Land Readjustment (LR) is a strategic tool for urban land management, reducing fragmentation. • Successful TPS implementation requires legal backing and institutional support. • Comparative studies show Gujarat's TPS model as an effective case for planned urbanization.

Table 19 literature review 02

Sr. No.	Title of the Paper	Author(s) / Source(s)	Objectives of the study	Key Findings
03	**Land Acquisition Vs. Land Pooling**	National Housing Bank, ASCI	• Compare the efficiency, equity, and implementation of land acquisition versus land pooling. • Analyze the socio-economic impacts of both mechanisms. • Evaluate compensation and resettlement models under both systems. • Study case examples of land acquisition and pooling from different states.	• Land pooling is a cost-effective and socially acceptable alternative to land acquisition. • Land acquisition often faces opposition due to displacement and compensation issues. • Different states have unique approaches, with Gujarat and Andhra Pradesh having notable models. • Successful implementation of land pooling requires strong governance and community participation.
04	**State-Led Alternative Mechanisms for Land Acquisition**	World Resources Institute	• Explore state-led land acquisition mechanisms integrating land planning and servicing. • Identify challenges in traditional land acquisition methods and propose alternatives. • Assess the effectiveness of Town Planning Schemes (TPS) and Public-Private Partnerships (PPPs). • Examine land value capture as a financing mechanism for urban projects.	• Identifies six alternative mechanisms like TPS, LPS, and PPPs for urban expansion. • Emphasizes land value capture techniques for sustainable urban development. • States adopting alternative mechanisms have witnessed better land utilization and urban planning. • Legal and financial frameworks play a critical role in successful implementation.

Table 18 literature review 01

Sr. No.	Title of the Paper	Author(s) / Source(s)	Objectives of the study	Key Findings
05	**Manual for Town Planning Schemes**	Gujarat Real Estate Regulatory Authority	• Provide step-by-step guidance for preparing and implementing TPS. • Highlight the benefits of TPS in urban development and land readjustment. • Assess TPS models in Gujarat and their effectiveness. • Develop recommendations for improving TPS mechanisms.	• TPS is a structured approach to urban development, integrating land reconstitution and value capture. • Gujarat TPS model has successfully managed urban expansion with planned infrastructure. • Proper land allocation and stakeholder involvement are crucial for TPS success. • Legal and institutional frameworks need to be continuously updated for better TPS execution.
06	**Ethno-Medicinal Uses of Promising Plants in Various Formulations in Cure of Ailments in Chhindwara District**	Rai R. (2016)	• Document the ethno-medicinal uses of 50 plant species prevalent in Chhindwara district. • Identify various plant formulations used in treating ailments such as leucoderma, diabetes, and heart disease. • Assess the role of traditional healers in conserving indigenous medical knowledge.	• Chhindwara is rich in ethnomedicinal plant diversity used by Bhariya and Gond tribes. • Herbal remedies are primarily prepared in forms like powder, decoction, and pastes. • Tribal healers possess vast yet undocumented medicinal knowledge, requiring urgent preservation. • Overharvesting and modernization are threatening traditional medicinal plant use.

Table 22 literature review 03

Sr. No.	Title of the Paper	Author(s) / Source(s)	Objectives of the study	Key Findings
07	**Medicinal Plants in India: An Assessment of their Demand and Supply**	Goraya, G.S. and Ved, D.K. (2017)	• Assess the demand and supply of medicinal plants in India. • Identify medicinal plant species under threat due to overharvesting. • Examine the trade and market dynamics of herbal raw drugs. • Suggest policy recommendations for the conservation of medicinal plants.	• India has 1,200 commercially used medicinal plant species, with 85% sourced from the wild. • Annual demand for herbal raw drugs in India is over 512,000 MT, growing at 10% annually • Unregulated harvesting is leading to the depletion of several medicinal plant species. • There is an urgent need for conservation, cultivation incentives, and policy interventions.
08	**Flora of Chhindwara District with Special Reference to Ethnobotany**	Dhurwe, U.K., & Diwan, R.K. (2019)	• Document ethnobotanical knowledge of Chhindwaras indigenous communities. • Identify medicinal plants used for primary healthcare in the district. • Understand the relationship between forest resources and tribal health systems. • Analyze conservation needs for medicinal plants in the region.	• 36 medicinal plant species are commonly used for ailments by Chhindwaras tribal healers. • Ethno-medicinal knowledge is inherited orally and is at risk of being lost due to modernization. • The most commonly used plant parts are leaves, roots, and bark. • There is a lack of formal documentation of tribal medicinal practices.

Table 21literature review 04

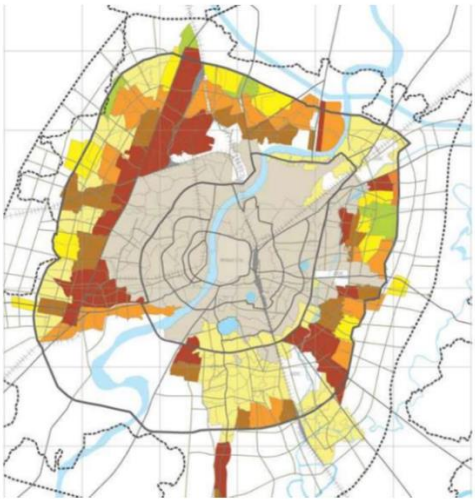
Chapter – 6

Case Study : TP Schemes of Ahmedabad

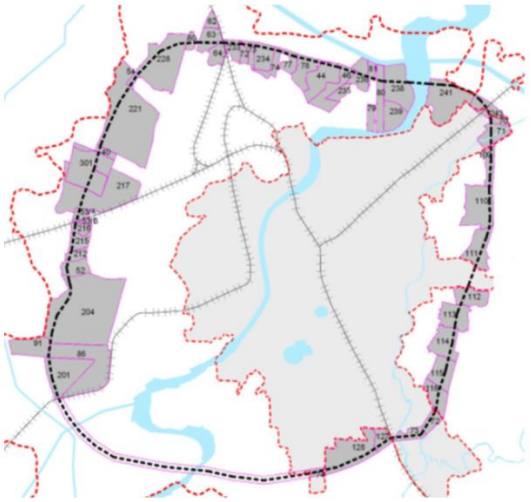
6.1 Area Delineation

The **first and most essential step** in the implementation of any Town Planning (TP) Scheme in Ahmedabad is the **identification and delineation of areas** where the scheme will be applied. TP Schemes in Gujarat are structured as **micro-level implementation tools** for the larger Development Plan (DP). They enable planning at a **parcel or neighborhood level** within the broader development vision. However, one of the key challenges historically observed is that **delineation of TP Schemes is often done separately** from the DP process, which leads to **lack of integration between vision and execution**. When TP schemes are initiated in **random, disconnected patches**, the resulting development tends to be **isolated, fragmented, and difficult to serve with public infrastructure**. This leads to poor implementation of trunk infrastructure and missed opportunities for planned growth. *(AUDA Guidelines for Preparation of Town Planning Schemes, 2020)*

To ensure that the DP objectives are achieved effectively on ground, it is critical that **TP Schemes be delineated in a continuous and coordinated manner across the entire DP area**. If this is done **at the DP stage itself**, it allows for the **sequential and strategic rollout** of TP Schemes. This promotes **network continuity**—especially for **transportation corridors, trunk drainage, water supply systems, and road hierarchies**. It also ensures **equitable distribution of amenities and open spaces** across the city. Without such continuity, schemes may lead to the emergence of **pocketed layouts**, which are difficult to integrate into the city's infrastructure backbone. Hence, Ahmedabad’s experience underlines the importance of delineating TP Schemes as an **integrated layer within the DP process**, not a post-plan add-on. *(AUDA, Development Plan and TPS Integration Manual, 2021)*



DP of Ahmedabad showing TPS with similar characteristics. - AUDA



TPS to carve out land abutting Outer ring road. - AUDA

Figure 27 tp schemes of ahmedabad

6.2 Fine Tuning TP Scheme Boundary

To ensure that TP Schemes in Ahmedabad are declared in the most strategic and timely manner, a set of **indicators and triggers** has been identified. These indicators help planners **prioritize areas** where a TP Scheme should be launched based on observed development pressure and readiness for urban intervention.

One of the most important indicators is the **zoning in the Development Plan (DP)**. If the DP has earmarked certain land for residential, commercial, or industrial purposes, the TP Scheme boundary should align with these zones to ensure seamless implementation. Another critical indicator is a **sudden rise in land transactions**—especially within the last five years—which indicates **growing land demand and speculative activity**, making it essential to regularize development through formal planning.

The **conversion of agricultural land to non-agricultural use** is also a strong signal of impending urbanization. It reflects a shift in land utility and an increase in development pressure. Additionally, the **course and trend of development**—including urban sprawl patterns and building activities—help define how the urban edge is evolving and where new TP Schemes may be required.

Further, a **rise in the number of development permissions issued** reflects market readiness and increased construction activities. Large infrastructure or institutional projects in nearby areas often create a **ripple effect**, increasing land demand and pushing surrounding areas to develop. This spillover effect necessitates proactive delineation of TP

Schemes to manage growth in an organized manner.

The **laying of roads by government agencies**, such as the Roads & Buildings Department or District Panchayats, also becomes a trigger, as these roads often stimulate new growth corridors. If **development is already happening in areas adjacent to existing TP Schemes**, it is wise to extend planning coverage to maintain urban continuity.

Finally, the **collective request of landowners** in a particular area can serve as a bottom-up trigger for scheme preparation. When landowners see value in formalization and request a TP Scheme, it provides administrative legitimacy and increases the chances of successful implementation.

Collectively, these nine indicators provide a **comprehensive framework** for timely, need-based, and responsive delineation of TP Scheme boundaries in Ahmedabad.

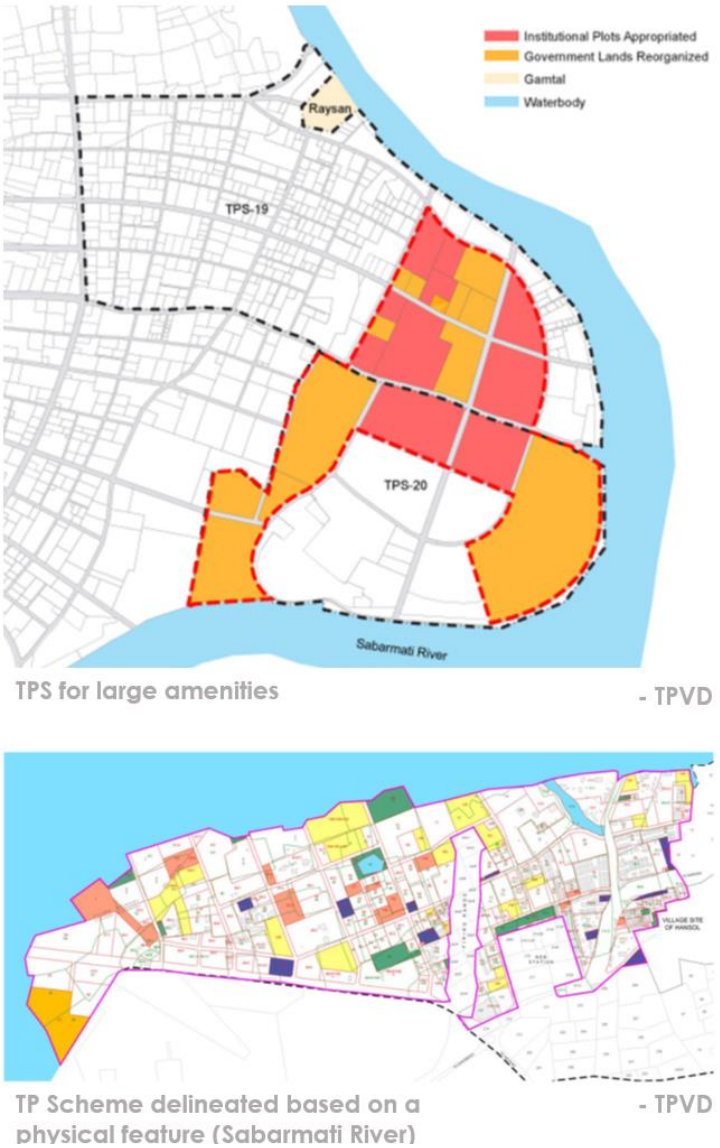


Figure 29 tp scheme delineation

6.3 Considerations for Delineating TP Scheme Boundaries

Delineating the boundaries of a Town Planning Scheme (TPS) is a critical step that must balance administrative manageability with planning logic. The first and foremost consideration is that the **TPS boundary should align with the same land use zone** as defined in the Development Plan (DP). This ensures uniformity in zoning regulations and eases the implementation of infrastructure and development controls.

It is also advisable to include **areas with similar planning characteristics**—such as land use type, road network pattern, or typology of built fabric—within the same TPS. Grouping such similar parcels enables the creation of a coherent and functionally integrated plan.

Rather than fixing a TPS by area alone, it should be designed to **keep the number of plot owners manageable**. A balanced number of landholders (like 100–150 owners per scheme) is administratively easier to handle, speeds up negotiations, and simplifies the land reconstitution process. This is why two TPS areas may differ in physical size but still have similar numbers of plot owners, as shown in the visual comparison of Scheme 121 and Scheme 27.

Different TPS can naturally **have varying sizes**, depending on contextual factors like plot sizes, urban density, and specific development goals in that area. For example, fringe areas with larger agricultural plots may yield schemes covering more hectares than inner urban sites.

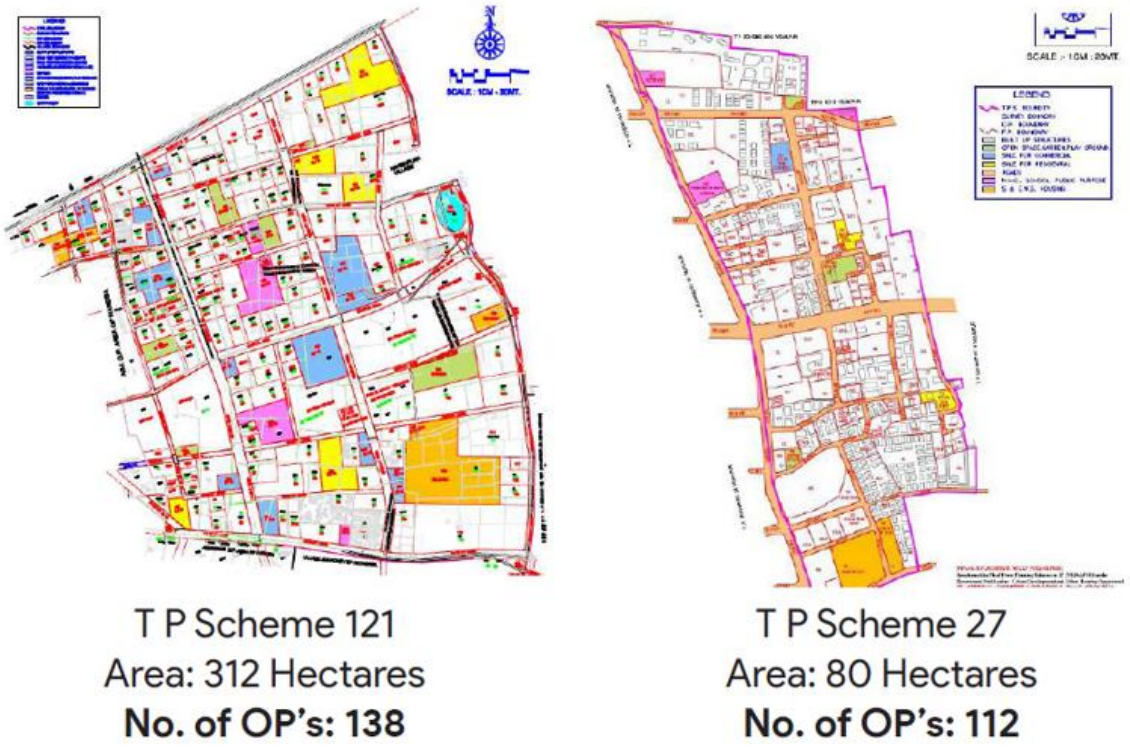
When defining the boundaries, planners should consider **natural or man-made physical barriers** such as rivers, streams, hills, railway tracks, village boundaries, or upcoming DP roads. These features provide logical and defensible edges to the scheme.

Further, **major DP roads or zoning boundaries** should act as guiding frameworks for the TPS boundary. These roads already serve as structural elements within the DP and provide ready-made limits for scheme design.

In cases where the scheme includes **large infrastructure elements or environmentally sensitive zones**, the area may need to be larger to ensure that enough land is contributed through reconstitution for public uses like roads, open spaces, or green buffers.

Lastly, when land availability or needs are spread across a wider region, **multiple contiguous TPS can be clustered** and planned together. This strategy helps maintain larger, uninterrupted land parcels while still breaking up the planning work into

manageable administrative units.


T P Scheme 121
Area: 312 Hectares
No. of OP's: 138
T P Scheme 27
Area: 80 Hectares
No. of OP's: 112
TPS with different areas but similar number of plot owners

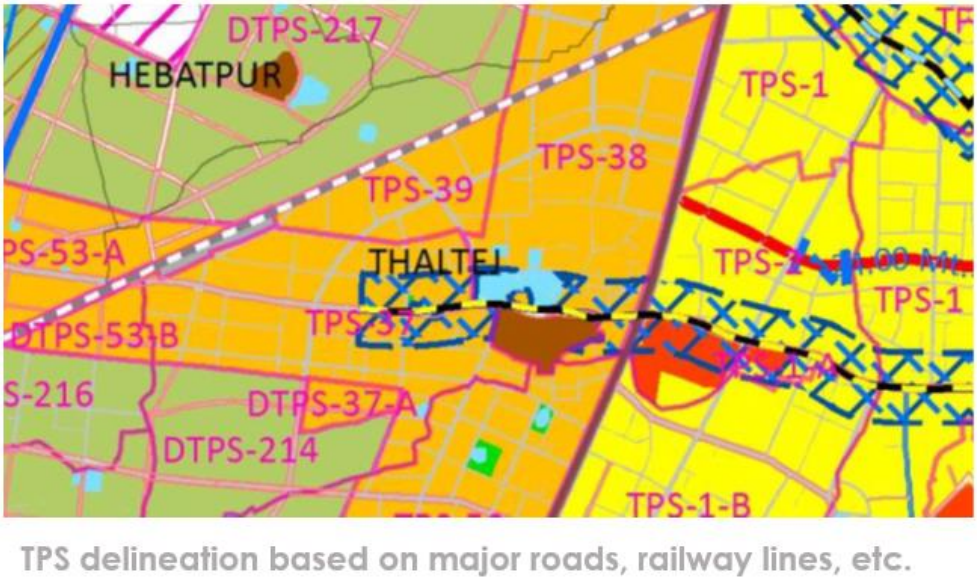


Figure 30 tp schemes delineation 02

6.4 Layered Analysis

To support the formulation of an effective Town Planning Scheme (TPS), a comprehensive assessment of the existing physical, legal, and environmental conditions is essential. In the Ahmedabad TPS case, the following layered analyses were conducted to understand the ground realities:

1. Analysis of Existing Plots & Land Use

This analysis examines the current utilization of land parcels—residential, commercial, institutional, industrial, and agricultural. Understanding the existing land use pattern helps planners identify dominant zones, incompatible adjacencies, and areas that may need reorganization or better zoning controls in the proposed TPS.

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2. Analysis of Building Use and Building Conditions

This layer classifies structures based on their present use (residential, institutional, mixed-use, etc.) and evaluates their physical condition. It helps in identifying dilapidated or underutilized structures, offering insights into where redevelopment or densification might be appropriate.

---

3. Analysis of Land Ownership

Land ownership is a critical determinant of feasibility in TPS. This layer differentiates between public and private lands, enabling identification of government lands that can be used for amenities, infrastructure, or land pooling contributions. It also helps assess the complexity of negotiations and implementation.

---

4. Analysis of Topography and Environmental Features

Topographic data, natural drainage, waterbodies, and vegetation cover are mapped to identify constraints or sensitive zones. These features guide the delineation of non-developable zones, flood-prone areas, or regions that require environmental buffers.

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5. Analysis of Development Suitability

Based on terrain slope, drainage, accessibility, and proximity to built-up areas, parcels are categorized as suitable or unsuitable for development. This analysis supports the strategic placement of new road networks, residential areas, and amenities.

---

6. Analysis of Infrastructure

The existing road network, water supply lines, sewage, and electrical infrastructure are studied to identify serviced versus unserviced areas. This helps in planning equitable infrastructure distribution and minimizing the cost of retrofitting in the TPS.

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7. Analysis of Transport Network

A hierarchy of roads—arterial, sub-arterial, and local—is mapped to assess connectivity and accessibility. This layer supports the development of a well-connected road layout within the TPS and ensures integration with the city's broader mobility network.

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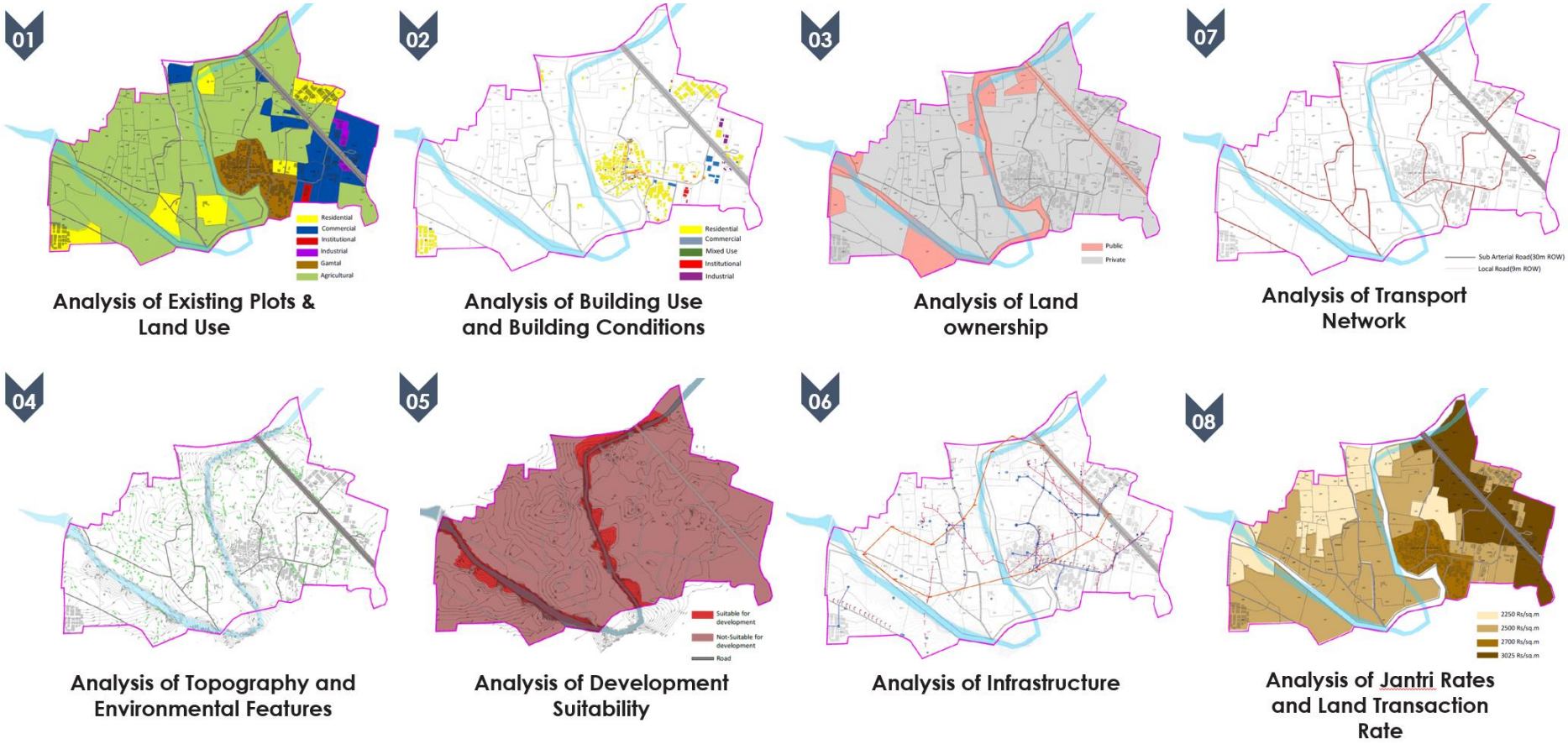
8. Analysis of Jantri Rates and Land Transaction Rate

This analysis reveals the economic dynamics by tracking land values and recent land transactions. High transaction zones indicate development pressure, market readiness, and speculative tendencies. This information helps prioritize TPS boundaries where land demand is high and development pressure is imminent.

Figure 31 map layers shwoing different factors affecting tp schemes



6.5 Case I

The **Vizol II Town Planning Scheme (TPS)** in Ahmedabad illustrates a successful example of land reconstitution, a core mechanism under TPS methodology. This case showcases how fragmented and irregular land parcels can be reorganized to create a more efficient and serviceable urban layout.

Before TPS

The area originally consists of **irregular, large, and poorly connected land parcels**, each owned by different individuals. These plots lack proper access roads and are disconnected from basic infrastructure. The central **village site** remains an isolated and underutilized zone with no integration into the broader urban structure.

During TPS Proposal

After delineating the TPS boundary, the land is **reorganized to introduce a clear road hierarchy**, including 30-meter roads that provide accessibility to all plots. The land is **redistributed proportionally** to original landowners after deducting a percentage (typically 40–50%) for public purposes. Key land reservations are made for:

- **Low-income housing** (hatched yellow)
- **Social infrastructure** such as schools and clinics (red)
- **Saleable plots** for commercial and residential uses (blue and yellow)

This phase ensures **equity** by allocating reconstituted plots of proportional value to landowners while reserving land for common urban needs.

After TPS Finalization

The final scheme ensures:

- **Compact and rectangular plots**, improving land efficiency.
- **Improved accessibility** via a structured road network.
- **Integrated public spaces** and infrastructure zones to enhance livability.
- The **village site** is preserved and better connected through green corridors and lakefront integration.

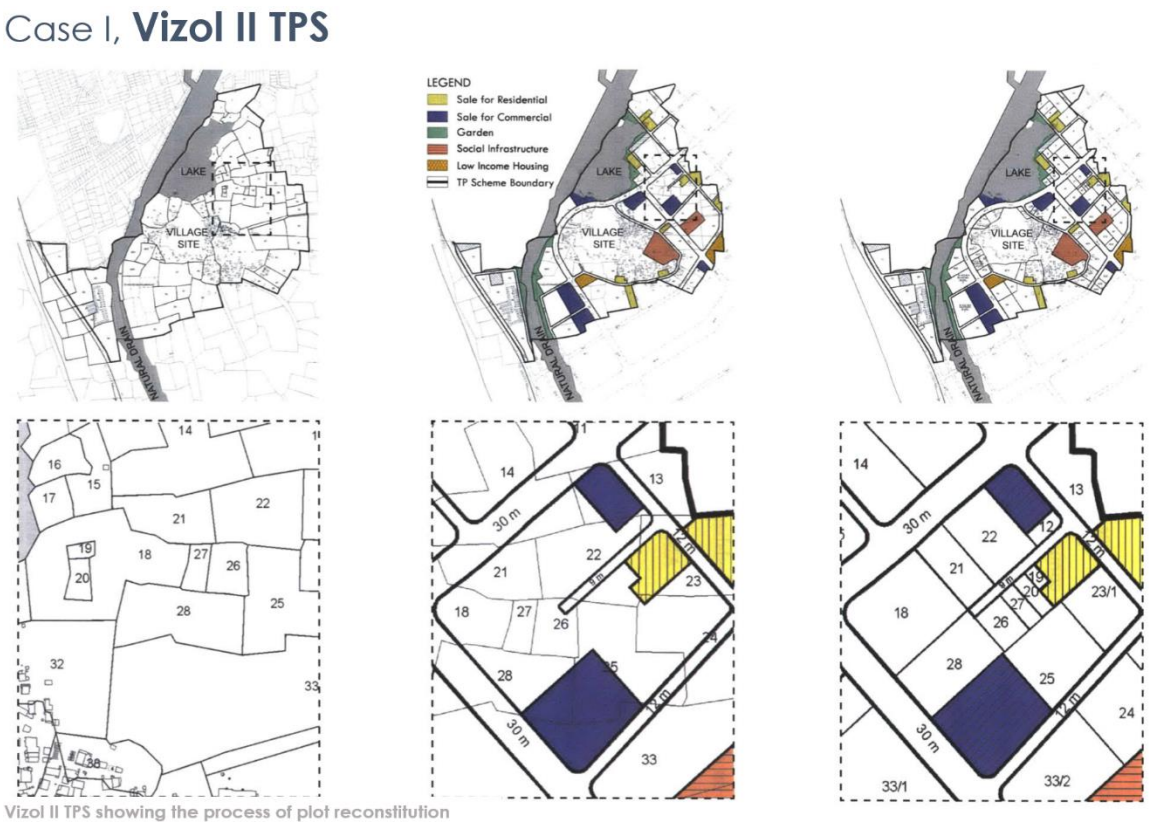


Figure 32 vinzol tp scheme

6.6 Case II

Narol Ranipur TPS – Transforming a Dense Urban Core

The **Narol Ranipur area**, located in southern Ahmedabad, presents a case of implementing TPS in a highly **built-up and congested urban environment**. The **pre-scheme satellite image (2003)** reveals an irregular pattern of dense settlements with limited road access and scarce public infrastructure.

The **draft Town Planning Scheme (TPS No. 62)** was sanctioned in **March 2005**. The scheme proposed a **clear hierarchy of roads**, restructured land parcels, and allocated land for:

- **Residential and commercial sale plots**
- **Low-income housing**
- **Gardens and social infrastructure**

Although the **implementation by May 2010** shows partial success (some roads had been laid), **many public amenities remained unbuilt**, reflecting the **slow on-ground execution** of the scheme despite formal planning being in place. The case demonstrates that even well-structured TPS designs may face hurdles in implementation when land is

already intensively used.

6.7 Case III

Hansol TPS – Challenges in Peri-Urban Expansion

The **Hansol TPS** covers a peri-urban area in **northern Ahmedabad**, characterized in 2003 by a **semi-rural land cover with agricultural uses and scattered development**. The **TPS No. 67**, sanctioned in **September 2004**, proposed a comprehensive plan to guide future urban growth through:

- **Organized reallocation of plots**
- Provision of **residential, commercial, and social infrastructure zones**
- **New road networks** to improve accessibility

However, by **January 2010**, satellite imagery revealed that the area still largely retained its pre-scheme state, with very little construction or public works initiated. This illustrates the **implementation lag** often observed in peripheral TPS zones, where **speculative land holding** and **weak governance pushbacks** can delay execution.

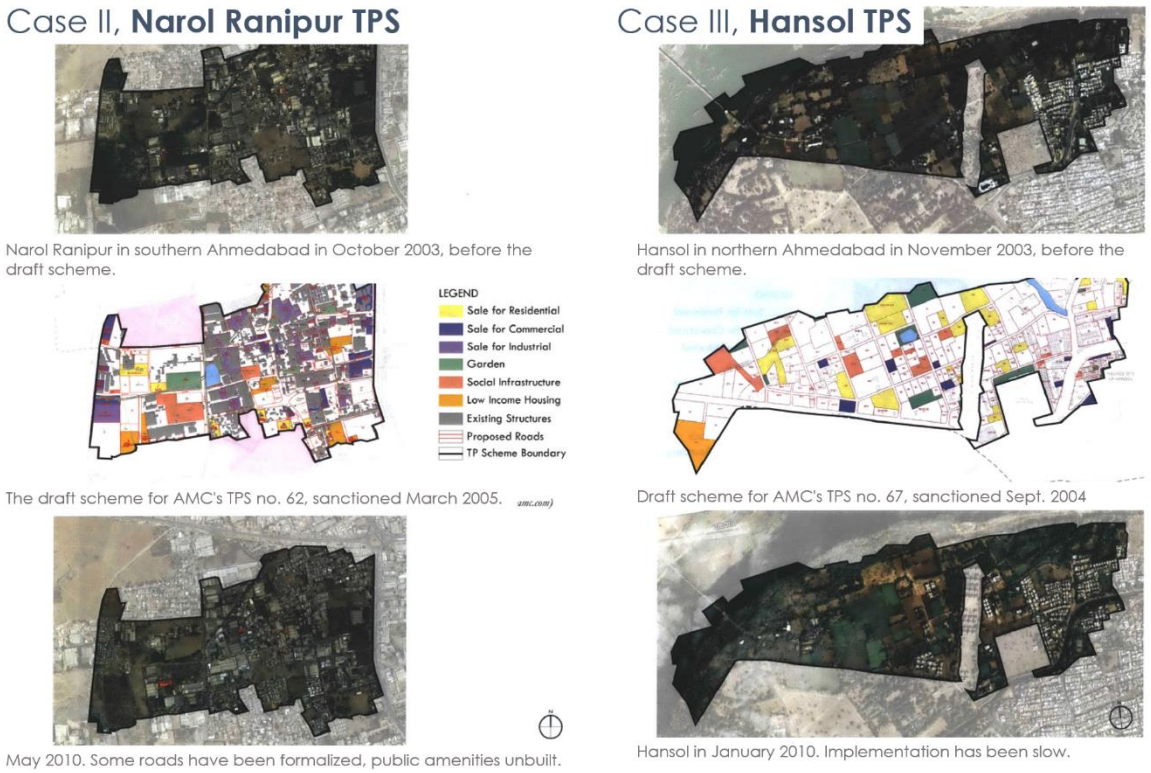

Case II, Narol Ranipur TPS
Narol Ranipur in southern Ahmedabad in October 2003, before the draft scheme.
LEGEND
Sale for Residential
Sale for Commercial
Sale for Industrial
Garden
Social Infrastructure
Low Income Housing
Existing Structures
Proposed Roads
TP Scheme Boundary
The draft scheme for AMC's TPS no. 62, sanctioned March 2005.
May 2010. Some roads have been formalized, public amenities unbuilt.
Case III, Hansol TPS
Hansol in northern Ahmedabad in November 2003, before the draft scheme.
Draft scheme for AMC's TPS no. 67, sanctioned Sept. 2004
Hansol in January 2010. Implementation has been slow.

Figure 33 narol and hansol tps

Key Takeaways

- **Narol Ranipur TPS** reflects the **challenges of retrofitting** existing dense urban areas through TPS.
- **Hansol TPS** shows the **implementation difficulties** in peri-urban contexts where development momentum is low.
- Both cases emphasize that **sanctioning a TPS is only the first step**—actual transformation depends on **timely land readjustment, stakeholder cooperation, and infrastructure rollout**.

6.8 Case IV

Nikol Kathwada TPS – A Linear Development Challenge

Nikol Kathwada TPS, located in **eastern Ahmedabad**, highlights the planning challenges in **elongated urban expansion corridors**. The **pre-scheme imagery from 2003** shows scattered agricultural and informal plots along a prominent arterial road. The **TPS No. 111**, sanctioned in **December 2003** under AUDA, introduced a detailed draft scheme featuring:

- A **hierarchical road network** overlaid on existing land ownership,
- Provisions for **residential, commercial, and industrial zones**,
- Deductions for **infrastructure and public amenities**.

By **May 2010**, development was visibly underway with road construction and organized parceling. However, the **linear nature** of this TPS created challenges for **comprehensive service distribution**, necessitating strong coordination across the narrow corridor. The case reflects how TPS can help formalize irregular growth even in elongated land parcels, but its success relies heavily on **road connectivity and infrastructure rollout**.

6.9 Case V

Prahlad Nagar TPS – A Model of Successful TPS Implementation

Prahlad Nagar TPS is often cited as one of the most **successful and structured TPS implementations** in Ahmedabad. Situated in **western Ahmedabad**, the area was largely agricultural in **2000**, but was covered by **four TPS drafts**, all sanctioned within the same year. Instead of implementing them independently, authorities **merged them into a**

unified, model TPS that:

- Integrated a **cohesive grid of internal roads**,
- Ensured equitable **land reconstitution**,
- Dedicated land for **social infrastructure**, **green spaces**, and **residential-commercial balance**.

By **May 2010**, the transformation was clear: the area had become a fully urbanized, livable zone with built-up residential blocks, formal commercial streets, and visible infrastructure like road lighting and public amenities.

Prahlad Nagar showcases how **synchronizing planning and execution** across overlapping TPS zones can ensure **rapid and harmonious development**, making it a **benchmark for replication** in new TPS rollouts.

Key Learnings from the Two Cases:

- **Nikol Kathwada**: TPS can formalize irregular linear growth, but faces challenges in infrastructure equity and plot accessibility.
- **Prahlad Nagar**: Unified implementation of multiple TPS zones fosters quicker and more coordinated urbanization, especially in new urban frontiers.

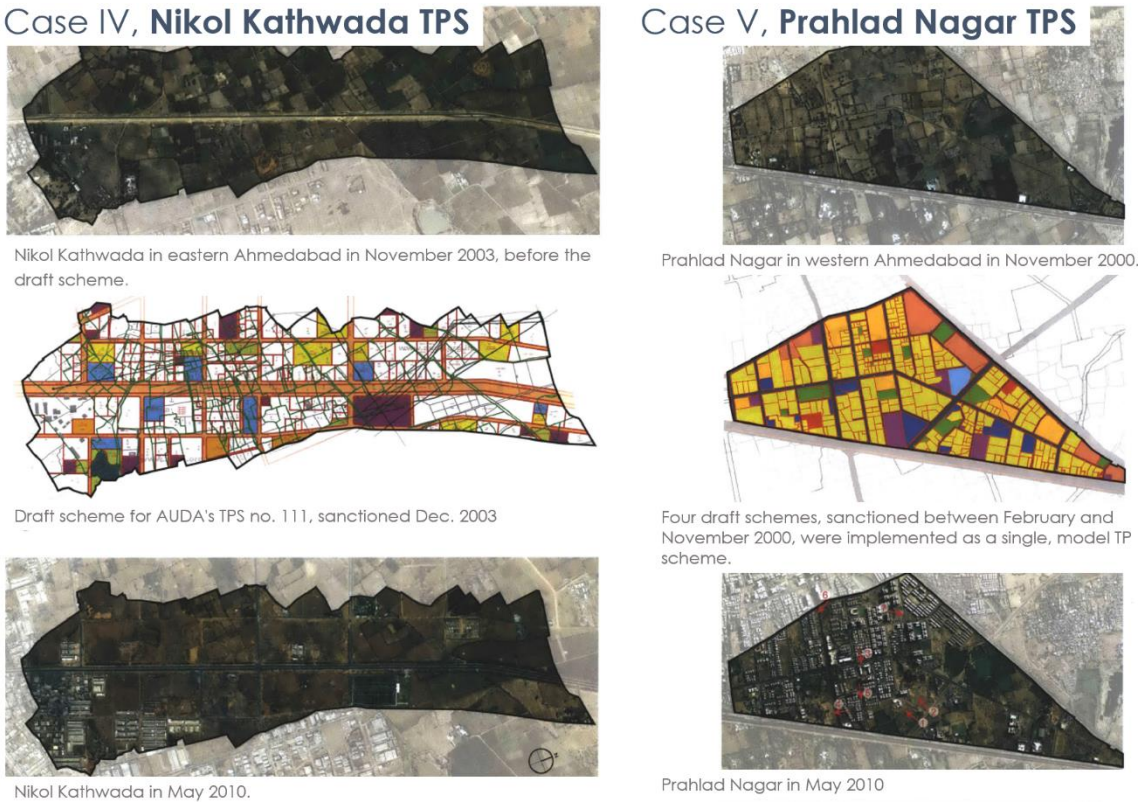

Case IV, Nikol Kathwada TPS
Nikol Kathwada in eastern Ahmedabad in November 2003, before the draft scheme.
Draft scheme for AUDA's TPS no. 111, sanctioned Dec. 2003
Nikol Kathwada in May 2010.
Case V, Prahlad Nagar TPS
Prahlad Nagar in western Ahmedabad in November 2000.
Four draft schemes, sanctioned between February and November 2000, were implemented as a single, model TP scheme.
Prahlad Nagar in May 2010

Figure 34 nikol and prahalad nagr tps

Chapter – 7

Survey & Primary Data Collection

7.1 Survey Form & Questionnaire

प्रिय प्रतिभागी,

नमस्ते! मेरा नाम **रुद्र लखेरा** है। मैं पेशे से **आर्किटेक्ट** हूँ और वर्तमान में **वी.एन.आई.टी. नागपुर** में "**नगर नियोजन**" में स्नातकोत्तर कर रहा हूँ। मेरे शोध प्रबंध का विषय "***छोटे शहरों के लिए निर्देशित शहरी विकास : छिंदवाड़ा के लिए एक क्षेत्र-आधारित विकास रणनीति***" है। इस परियोजना के लिए, मैं ***छिंदवाड़ा शहर*** के निवासियों से कुछ महत्वपूर्ण जानकारी एकत्र करना चाहता हूँ, जो इस अध्ययन में सहायक होगी। आपका बहुमूल्य समय और सहयोग इसके लिए अत्यंत महत्वपूर्ण है।

कृपया निम्नलिखित प्रश्नावली को ध्यानपूर्वक पढ़ें और अपने उत्तर प्रदान करें। आपकी सभी जानकारी गोपनीय रखी जाएगी और केवल शैक्षणिक उद्देश्यों के लिए उपयोग की जाएगी।

1. **आपका नाम** (लघु उत्तर)
2. **आपका लिंग**
    - पुरुष
    - महिला
3. **आपकी आयु**
    - 18 वर्ष से कम
    - 18-30 वर्ष
    - 31-45 वर्ष
    - 46-60 वर्ष
    - 60 वर्ष से अधिक
4. **आपका शैक्षिक स्तर**
    - अनपढ़
    - प्रारंभिक शिक्षा
    - माध्यमिक शिक्षा
    - उच्चतर माध्यमिक शिक्षा
    - स्नातक
    - स्नातकोत्तर या उससे अधिक
    - अन्य
5. **आप छिंदवाड़ा में कितने वर्षों से निवास कर रहे हैं?**
    - 1 वर्ष से कम

- 1-5 वर्ष
- 6-10 वर्ष
- 11-20 वर्ष
- 20 वर्ष से अधिक

6. **आपका व्यवसाय/रोज़गार**
    - सरकारी सेवा
    - निजी सेवा
    - स्वरोजगार/व्यवसाय
    - कृषि
    - छात्र
    - बेरोज़गार
    - गृहिणी/गृहपति
    - अन्य
7. **क्या आप छिंदवाड़ा में उपलब्ध बुनियादी सुविधाओं से संतुष्ट हैं? (जैसे सड़के, पानी, बिजली आदि)**
    - हाँ
    - नहीं
    - कुछ हद तक
8. **शहर में बढ़ते अनियोजित शहरी फैलाव (Urban Sprawl) के बारे में आपका क्या विचार है?** (लंबा उत्तर)
9. **क्या आप मानते हैं कि छिंदवाड़ा में आर्थिक गतिविधियों (जैसे वन उत्पाद, कृषि, घरेलू उद्योग) को बढ़ावा देने की आवश्यकता है?**
    - हाँ
    - नहीं
    - कोई राय नहीं
10. **आपके अनुसार, छिंदवाड़ा में कौन से क्षेत्र आर्थिक विकास के लिए प्राथमिकता में होने चाहिए?**
    - वन उत्पाद
    - कृषि
    - घरेलू उद्योग
    - पर्यटन
    - अन्य
11. **छिंदवाड़ा में सार्वजनिक परिवहन की वर्तमान स्थिति के बारे में आपका क्या विचार है?**
    - बहुत अच्छा
    - अच्छा
    - संतोषजनक

- खराब
- बहुत खराब

12. **क्या आप शहर में नए औद्योगिक क्षेत्रों की स्थापना का समर्थन करते हैं, यदि इससे रोज़गार के अवसर बढ़ते हैं?**
    - हाँ
    - नहीं
    - कोई राय नहीं
13. **आपके विचार में, छिंदवाड़ा के सतत विकास के लिए कौन से कदम उठाए जाने चाहिए?** (लंबा उत्तर)
14. **क्या आप मानते हैं कि छिंदवाड़ा शहर में अनियमित विकास के कारण सड़क नेटवर्क और बुनियादी ढांचे की व्यवस्था अव्यवस्थित हो गई है?**
    - हाँ, बिल्कुल
    - कुछ हद तक
    - नहीं
    - पता नहीं
15. **क्या आपको अपने क्षेत्र में सड़कों, नालियों, और पार्किंग जैसी बुनियादी समस्याएँ महसूस होती हैं?**
    - हाँ, बहुत अधिक
    - कभी-कभी
    - नहीं, सब ठीक है
16. **क्या आप मानते हैं कि शहर के विकास के लिए एक सुनियोजित (planned) दृष्टिकोण अपनाना आवश्यक है?**
    - हाँ
    - नहीं
    - निश्चित नहीं
17. **यदि आपके क्षेत्र के विकास के लिए "टाउन प्लानिंग स्कीम (Town Planning Scheme)" जैसी योजना लागू की जाए, तो क्या आप उसका समर्थन करेंगे?**
    - हाँ, समर्थन करूंगा
    - नहीं करूंगा
    - जानकारी नहीं है / निर्णय नहीं कर सकता
18. **टाउन प्लानिंग स्कीम या भूमि पुनर्गठन (Land Readjustment) की प्रक्रिया में आमतौर पर एक ज़मीन मालिक को उसकी मूल भूमि का लगभग 20% से 40% हिस्सा सार्वजनिक उपयोग (जैसे सड़क, पार्क, तालाब आदि) के लिए देना होता है। लेकिन बदले में उसे एक सुव्यवस्थित (serviced) प्लॉट मिलता है, जिसकी बाज़ार में कीमत ज़्यादा होती है और जिससे उसे बेहतर लाभ मिलता है। ऐसी स्थिति में, क्या आप इस प्रक्रिया का समर्थन करेंगे?**

- हाँ, यदि सार्वजनिक और व्यक्तिगत दोनों को लाभ होता है तो मैं समर्थन करूंगा
- नहीं, मैं अपनी भूमि का कोई हिस्सा नहीं देना चाहता
- जानकारी नहीं है / निर्णय नहीं कर सकता

19. **आप जिस भूमि पर निवास करते हैं, वह किस प्रकार की है?**
    - कृषि भूमि
    - खाली/उजाड़ भूमि
    - निर्मित क्षेत्र (बिल्ट-अप)
    - सड़क किनारे
    - जल निकाय के समीप
    - अन्य
20. **आपके अनुसार भूमि की सतह कैसी है?**
    - समतल और खुला मैदान (Pediplain)
    - ढलान वाली ऊँची भूमि (Plateau/ Mesa)
    - पथरीली भूमि या कटाव वाला क्षेत्र (Scarp/Butte)
21. **आपके क्षेत्र में भूजल की उपलब्धता कैसी है?**
    - अच्छा (पानी कम गहराई पर और सालभर उपलब्ध)
    - मध्यम (पानी सीमित स्तर तक ही उपलब्ध)
    - बहुत कम (गहराई पर भी पानी नहीं मिलता)
    - जानकारी नहीं है
22. **आपके क्षेत्र की मिट्टी का प्रकार क्या है? (आपके अनुभव के आधार पर)**
    - बलुई या दोमट मिट्टी (Sandy/Loamy)
    - गहरी/चिकनी मिट्टी (Clayey)
    - पथरीली या कठोर मिट्टी (Skeletal)
    - जानकारी नहीं है
23. **आपके घर/प्लॉट से मुख्य सड़क की दूरी कितनी है?**
    - 100 मीटर से कम
    - 100-200 मीटर
    - 200-500 मीटर
    - 500 मीटर से अधिक
24. **क्या कोई तालाब/नदी/नहर आपके क्षेत्र के पास है? यदि हाँ, तो कितनी दूरी पर?**
    - 15 मीटर के भीतर
    - 30 मीटर के भीतर
    - 45 मीटर के भीतर
    - 60 मीटर या उससे अधिक

- कोई जल निकाय नहीं है

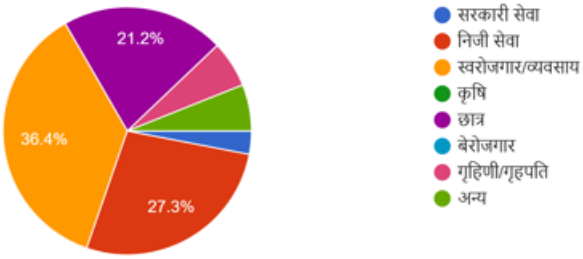
25. **आपके क्षेत्र की भूमि की ढलान कैसी है?**
    - बिल्कुल समतल (0–1%)
    - हल्की ढलान (1–3%)
    - मध्यम ढलान (3–5%)
    - तीव्र ढलान (5–10%)
    - जानकारी नहीं
26. **आपके क्षेत्र में एक वर्गफुट ज़मीन की औसत कीमत कितनी है? (आपके अनुमान के अनुसार)**
    - ₹465 से कम
    - ₹465 – ₹930
    - ₹930 – ₹1,395
    - ₹1,395 – ₹1,860
    - ₹1,860 – ₹2,325
    - ₹2,325 – ₹3,720
    - ₹3,720 – ₹5,580
    - ₹5,580 – ₹9,300
    - ₹9,300 से अधिक

7.2 Responses

01

आपका व्यवसाय/रोजगार

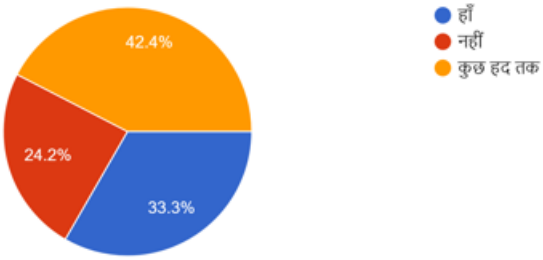
33 responses



02

क्या आप छिंदवाड़ा में उपलब्ध बुनियादी सुविधाओं से संतुष्ट हैं ? (जैसे सड़कें, पानी, बिजली आदि)

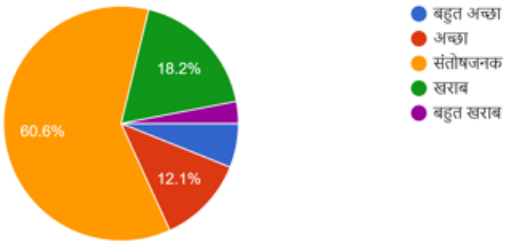
33 responses



03

छिंदवाड़ा में सार्वजनिक परिवहन की वर्तमान स्थिति के बारे में आपका क्या विचार है ?

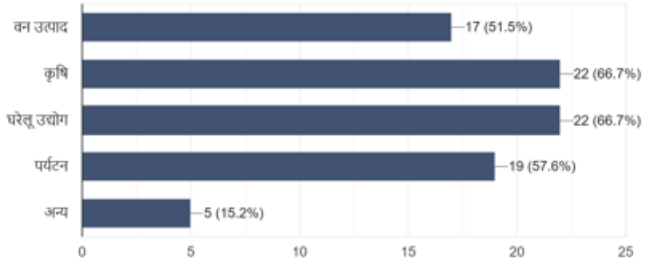
33 responses



04

आपके अनुसार, छिंदवाड़ा में कौन से क्षेत्र आर्थिक विकास के लिए प्राथमिकता में होने चाहिए ? (आप एक से अधिक चुन सकते हैं)

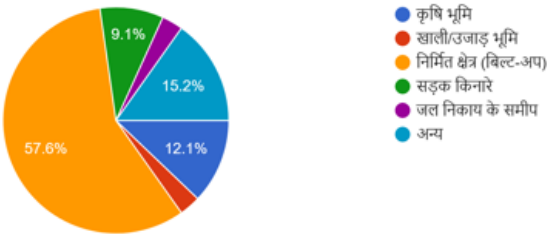
33 responses



05

आप जिस भूमि पर निवास करते हैं , वह किस प्रकार की है ?

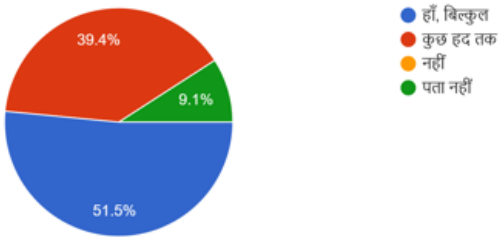
33 responses



06

क्या आप मानते हैं कि छिंदवाड़ा शहर में अनियमित विकास के कारण सड़क नेटवर्क और बुनियादी ढाँचे की व्यवस अव्यवस्थित हो गई है ?

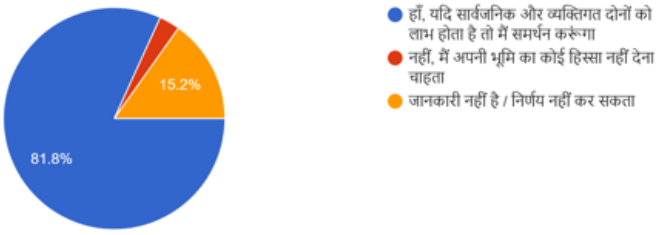
33 responses



07

टाउन प्लानिंग स्कीम या भूमि पुनर्गठन (Land Readjustment) की प्रक्रिया में आमतौर पर एक ज़मीन मालिक को उसकी मूल भूमि का लगभग 20% से 40% हिस्सा सार्वजनिक उपयो...ी स्थिति में, क्या आप इस प्रक्रिया का समर्थन करेंगे ?

33 responses



08

आपके क्षेत्र में एक वर्गफीट ज़मीन की औसत कीमत कितनी है ? (आपके अनुमान के अनुसार)

33 responses

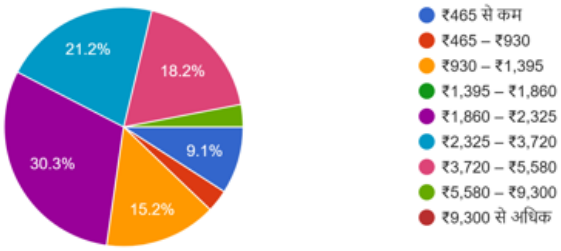


Figure 35 primary data survey response

7.3 Key Observations

The public opinion survey conducted in Chhindwara city reveals key insights regarding livelihood patterns, access to services, perceptions of planning, and willingness toward land-based urban interventions.

- **Occupational Profile:** A majority of respondents are engaged in private sector employment (36.4%), followed by those in self-employment or businesses (27.3%). Government service employees constitute 21.2%, while the remaining include homemakers, students, and unemployed individuals.
- **Access to Basic Amenities:** Approximately **42.4%** of residents feel that basic urban services like roads, water, and electricity are only partially satisfactory, while **33.3%** expressed satisfaction. However, **24.2%** of respondents stated they are dissatisfied, indicating a clear demand for improved service delivery.
- **Condition of Public Transport:** A significant proportion (**60.6%**) of respondents rated the public transport system in Chhindwara as merely **"satisfactory"**, with **18.2%** calling it "good," and **12.1%** labeling it "poor." Only a small fraction marked it as "very good" or "very poor," reflecting moderate public confidence in current mobility infrastructure.
- **Priority Areas for Economic Development:** Respondents identified **tourism (57.6%)** as the most critical sector for Chhindwara's economic growth, followed by **forest-based products (51.5%)** and **domestic industries (66.7%)**. This trend highlights the public's recognition of Chhindwara's cultural and natural economic assets.
- **Nature of Land Occupied:** More than half the respondents (**57.6%**) reported residing in **built-up areas**, followed by **agricultural lands (15.2%)** and **vacant lands (12.1%)**, while a smaller portion reported living on roadside or near water bodies.
- **Perception on Unplanned Growth:** A majority (**51.5%**) of respondents agreed that unregulated growth has led to disorganized road networks and service distribution. Around **30.4%** strongly agreed with this, suggesting a strong public awareness about the negative impacts of unguided urban expansion.
- **Acceptance of Land Readjustment (TP Scheme):** An overwhelming **81.8%** of residents supported the land readjustment approach if it ensured improved and

serviced plots. This indicates a favorable attitude toward Town Planning Schemes when benefits are made clear.

- **Estimated Land Value:** Responses on land value show a diverse distribution. Most respondents (30.3%) estimated land prices in the range of **₹1,395 – ₹1,860 per sq ft**, followed by 21.2% who estimated values above ₹9,300 per sq ft. This wide range reflects both the spatial disparity and the speculative valuation present in the city's land market.

Chapter – 8

Analysis

8.1 Landcover Projection using *Cellular Automata*

To assess the future trajectory of urban growth in Chhindwara, a **Cellular Automata (CA)** based simulation model was employed using a combination of base and influencer data rasters. This approach helps visualize the impact of key spatial drivers on land transformation over time and offers data-backed insights for guiding future planning decisions.

Base Data Rasters: Understanding the Temporal Urban Footprint

1. **Landcover Maps (2015, 2020, 2025):**

   The raster-based landcover datasets from the years 2015, 2020, and 2025 were the foundational inputs. These maps visibly capture **progressive urban expansion** in Chhindwara, with a marked **increase in built-up areas**—shown in red—**replacing agricultural lands and open spaces** (depicted in green). This temporal progression indicates an outward radial sprawl from the urban core, especially toward the northeast and southern peripheries.
2. **Temporal Input for CA Model:**

   These raster datasets were used to **train the Cellular Automata model temporally**, allowing the model to learn from past land conversion patterns. The **transition patterns** between different land classes (especially from agriculture/open to built-up) formed the basis for predicting future expansion.
3. **Identification of Transition Rules:**

   The CA model interprets these landcover changes to derive **transition rules**, which are spatially influenced by factors like proximity to infrastructure, existing urban edges, and accessibility. This allows the model to simulate **where** and **how fast** new development is likely to occur under current growth trends.

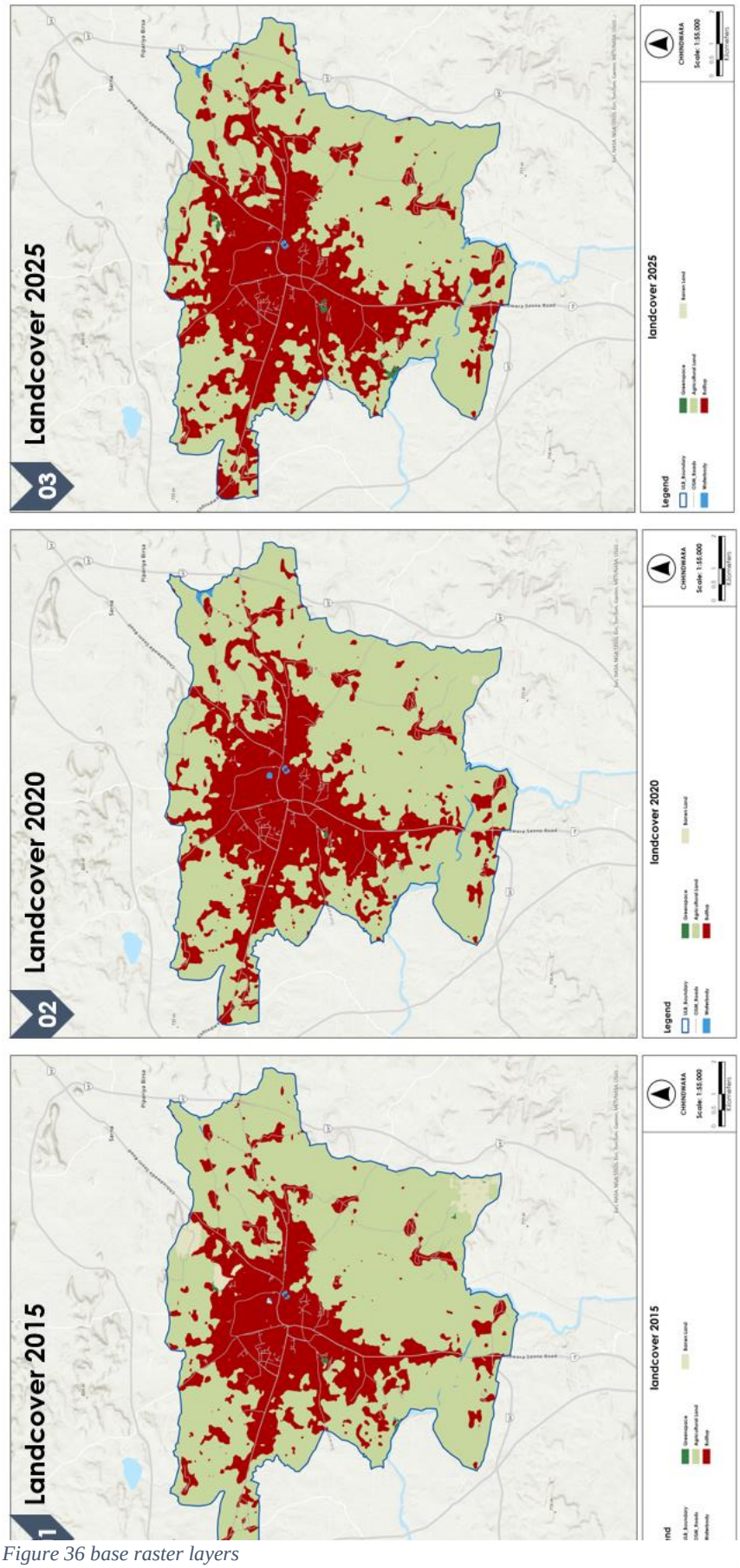


Figure 36 base raster layers

Influencer Data Rasters: Terrain and Accessibility as Growth Determinants

1. **Digital Elevation Model (DEM):**

   The DEM raster highlights the **terrain elevation gradient** across Chhindwara. Areas with steeper slopes (marked in yellow) and low-lying flood-prone zones (marked in dark blue) are less conducive to future development. By incorporating DEM, the simulation avoids suggesting expansion in topographically challenging or ecologically vulnerable areas, ensuring environmental feasibility.

2. **Proximity to Roads:**

   Accessibility remains one of the strongest predictors of urban growth. The raster showing proximity to roads demonstrates how **development radiates outward along major road networks**, indicating the influence of mobility corridors on land use change. Denser road proximity zones (highlighted in purple and red) tend to attract earlier development in the CA model output.

3. **Proximity to Waterbodies:**

   Areas close to water bodies are treated with caution in the simulation. The model incorporates **buffering from water bodies** to restrict potential ecological degradation and prevent encroachment into riparian zones. This is critical for preserving **urban water security and flood resilience**.

4. **Combined Influence on Simulation:**

   These influencer rasters were spatially aligned with the landcover data to **calibrate and constrain the CA model**. As a result, the simulation not only projects likely expansion zones but also **discourages sprawl in environmentally sensitive or infrastructure-deficient areas**.

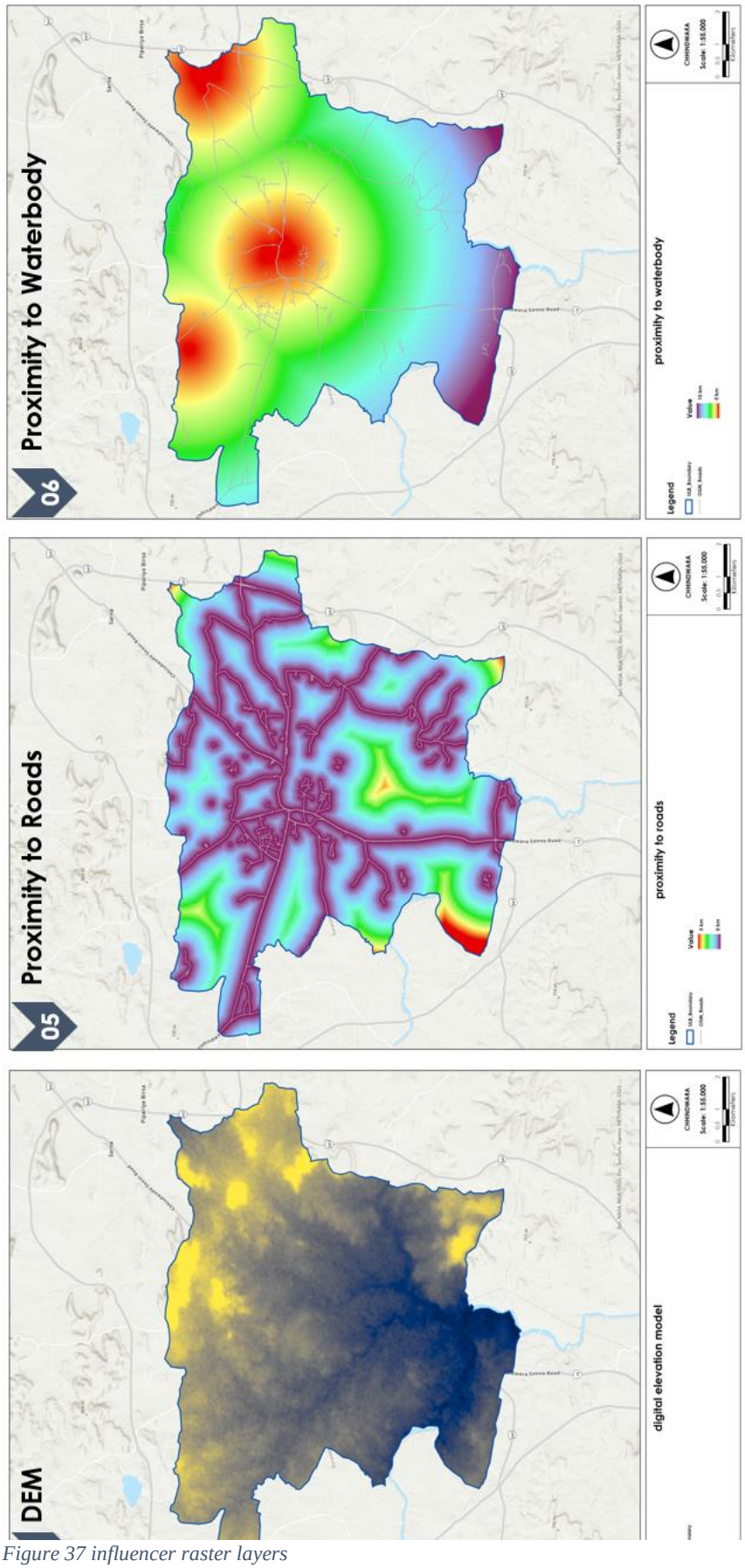


Figure 37 influencer raster layers

Projected Landcover (2035 and 2045): Patterns of Urban Encroachment

The 2035 and 2045 landcover projections exhibit a clear trajectory of **peripheral urban expansion**, particularly radiating from the central urban core toward southern, eastern, and northeastern zones. By 2045, **a substantial portion of agricultural and open lands have been converted into built-up areas**, indicating strong urbanization pressure in the peri-urban tracts.

This expansion, however, is **spatially incoherent**, with the emergence of **fragmented and corridor-like growth**, pointing to **organic, unregulated sprawl** rather than structured development. The growth follows accessible routes but lacks consistent zoning logic or cohesive urban form.

Sprawl Intensity Map: Identifying Growth Hotspots

The sprawl raster further delineates the **zones of rapid urban transition**, with the highest sprawl intensities concentrated:

- Along major transportation corridors heading north and southeast.
- In peripheral lands bordering existing urban nodes.
- In low-resistance terrain with proximity to roads and utility infrastructure.

The **sprawl is not evenly distributed**, indicating that while some areas experience excessive land consumption, others remain **underutilized due to connectivity and planning voids**.

Key Observations from Simulation Output

1. **Uncontrolled Outward Expansion:**
   The 2045 scenario shows **major horizontal urban sprawl** compared to 2015, with little emphasis on spatial efficiency. The urban footprint has expanded dramatically but without cohesive form, threatening long-term sustainability.
2. **Limited and Patchy Infill Development:**
   Although infill within older built-up zones is visible, the pattern remains

uncoordinated and sparse. This indicates an **absence of structured zoning or urban renewal strategies**, allowing inner areas to stagnate even as new lands are urbanized.

3. **Neglected Peripheral Growth Areas:**
   Some high-suitability areas identified in the earlier suitability analysis remain **underdeveloped by 2045**, particularly in the southern and southeastern tracts. This is likely due to **limited infrastructure access, lack of road integration, and absence of planning interventions**.
4. **Need for Guided Development:**
   The fragmented urban growth reinforces the need for a **comprehensive land use strategy**, emphasizing:
   - Transit-accessible growth nodes
   - Strengthened zoning regulations
   - Timely infrastructure provision
   - Sprawl management and green buffer preservation

Model Training Accuracy and Learning Dynamics

The Artificial Neural Network model used to calibrate the CA simulation consisted of:

- **3 hidden layers**
- **Learning rate:** 0.001
- **Momentum:** 0.05
- **500 iterations** over **5000 randomly sampled training pixels**

The **model's accuracy** was robust, achieving:

- **Validation Kappa Score:** 0.7794
- **Minimum validation error:** 0.02998

The learning curve shows **stable convergence**, minimal overfitting, and consistent error minimization across training and validation phases—affirming the model's **strong predictive capability** for spatiotemporal land cover transitions.

Conclusion

This landcover projection strongly suggests that **if current trends continue unchecked**, Chhindwara faces a future of **inefficient, low-density, and infrastructure-stressed urban form**. Proactive spatial planning interventions—including **zoning reform, compact growth principles, and transit-oriented design**—are essential to mitigate emerging sprawl patterns and ensure resilient, equitable urban development.

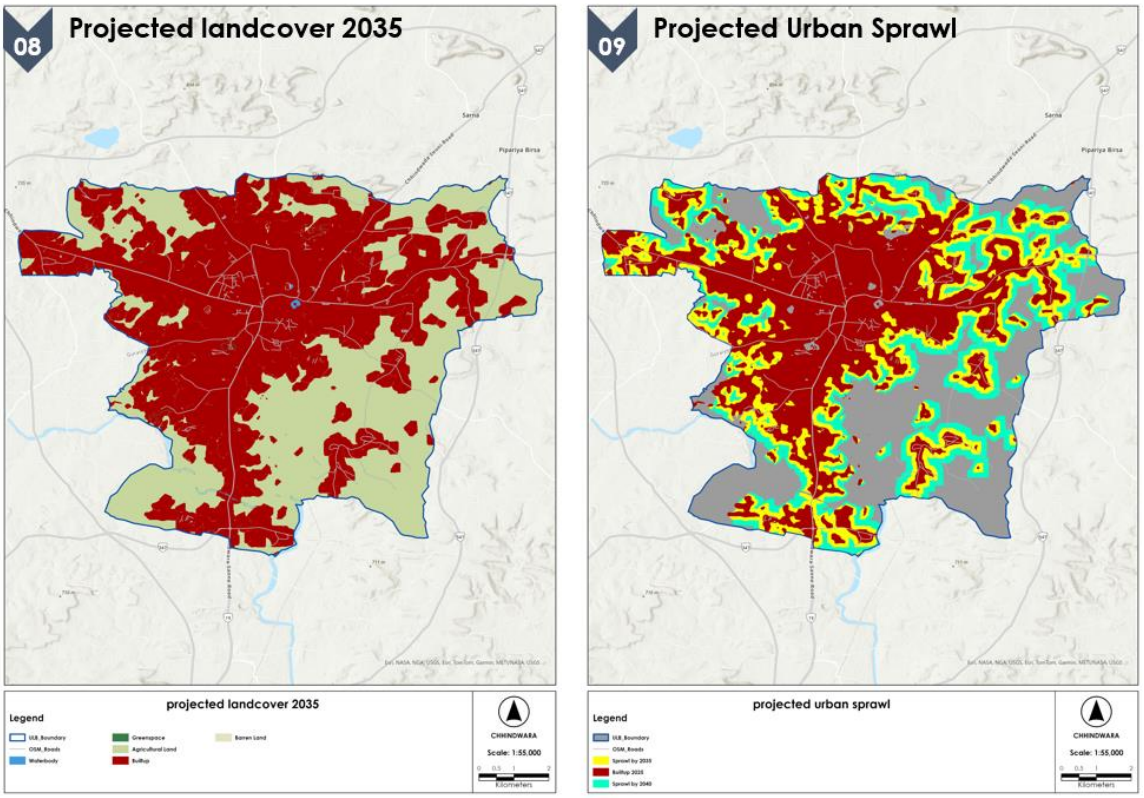


Figure 38 figures shwoing projected landcover and graph of neural network learning curve

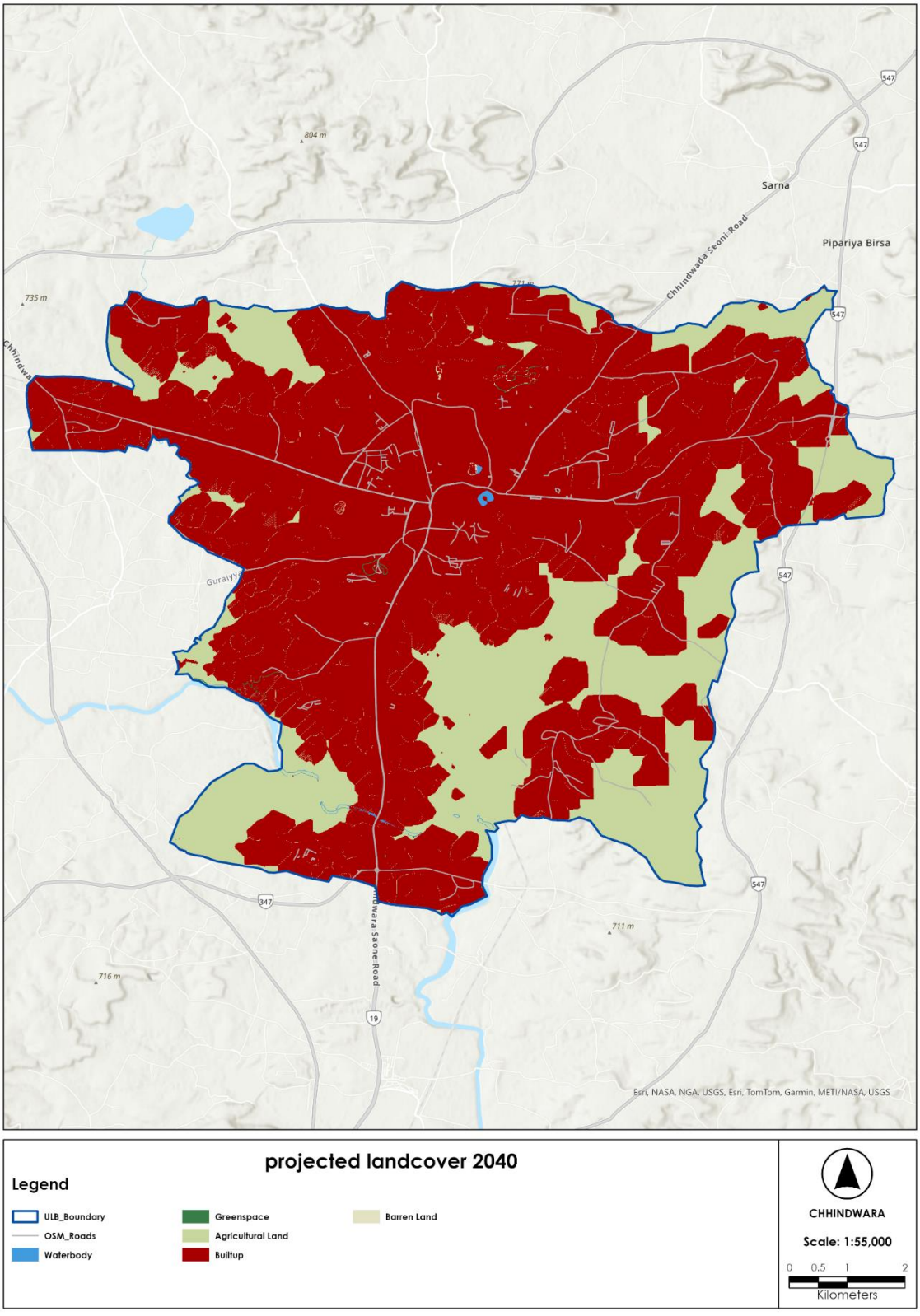


Figure 39 projected landcover 2045

8.2 Land Suitability Analysis

1. Land Parcel Sizes:

This layer analyzes the distribution of parcel sizes across Chhindwara's municipal limits. It was observed that the city core consists of extremely small and fragmented plots, rendering it inefficient for future development interventions such as land pooling or reconstitution. Hence, the core is deliberately excluded from suitability. Instead, larger and contiguous peri-urban parcels are prioritized. These offer better opportunities for infrastructure layout and block-level planning while minimizing acquisition complexity.

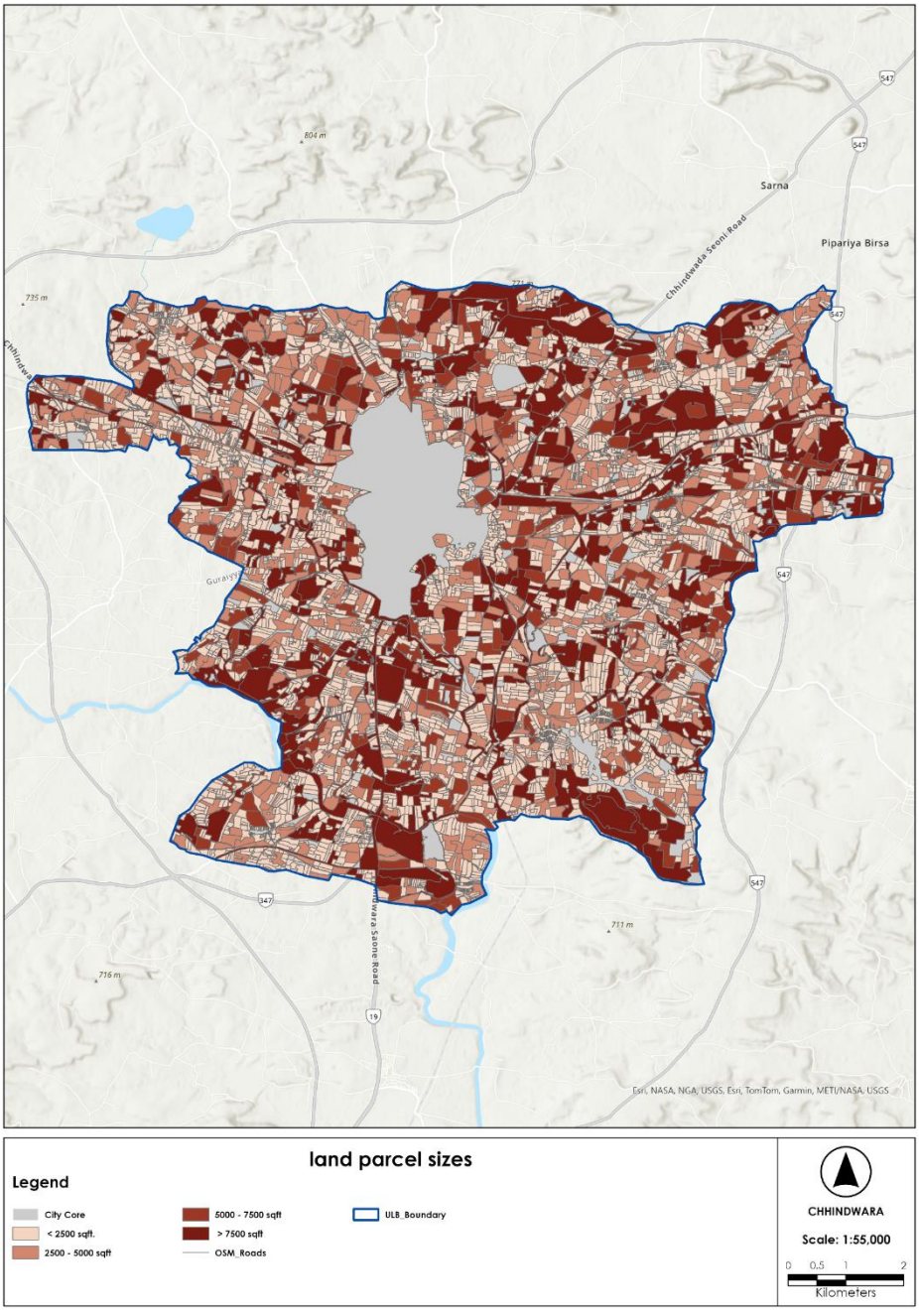


Figure 40 land parcel sizes

2. Natural Water-Drain:

The natural drainage system and watershed patterns across the region are mapped through this layer. Areas along streams and low-lying basins are considered ecologically sensitive and unsuitable for dense urban development. This map helps planners avoid flood-prone zones and environmental degradation during urban expansion, ensuring more resilient and sustainable growth corridors.

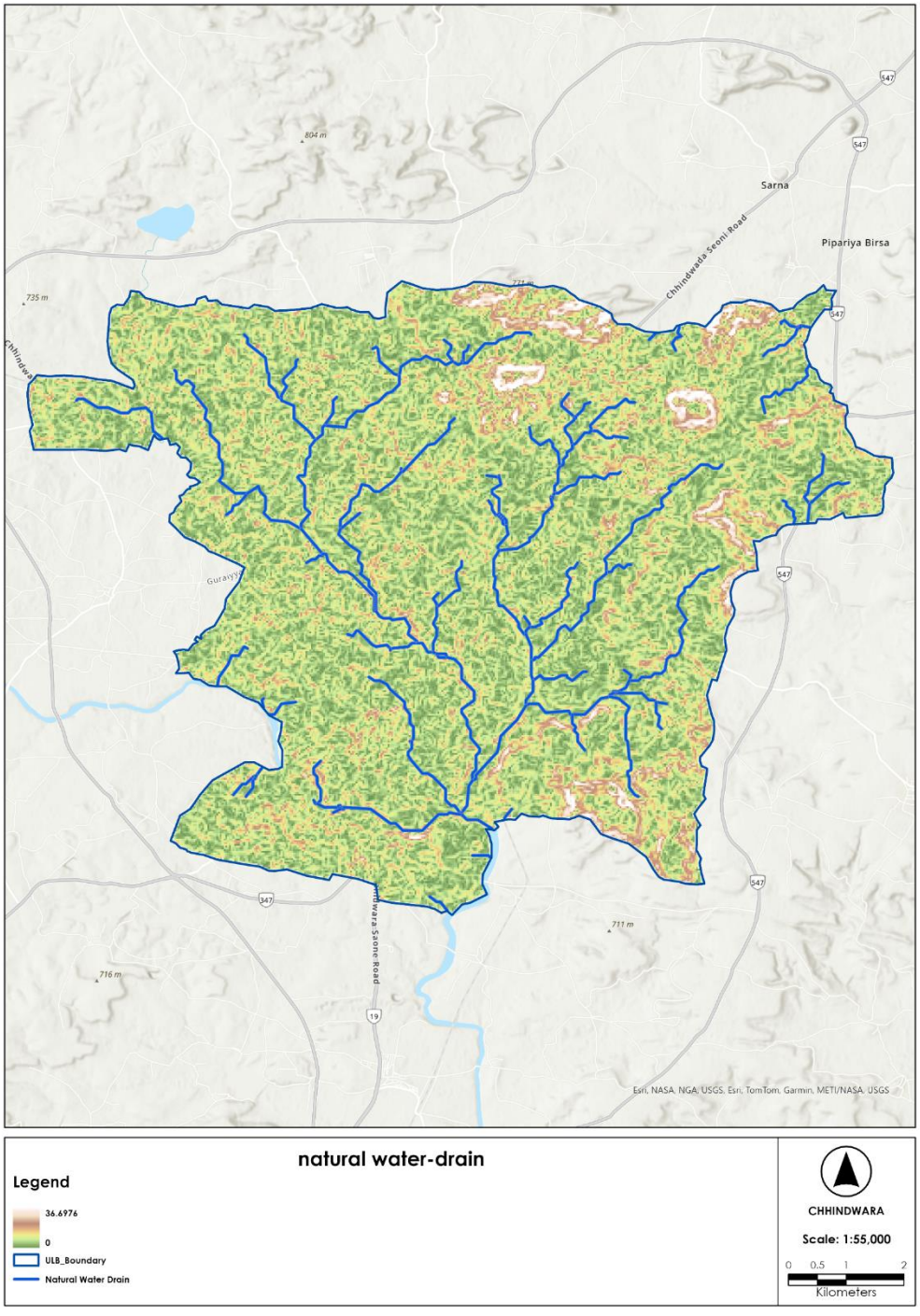


Figure 41 natural water drain

3. Exiting LandUse 2023:

Current land use distribution—built-up, agriculture, open space, and vacant land—is mapped for 2023. This layer is crucial for identifying transition zones where agriculture or open land is being gradually converted for urban uses. Underutilized or partially developed land near the urban fringe is especially noted as a suitable area for structured development, offering a balance between existing infrastructure and expansion potential.

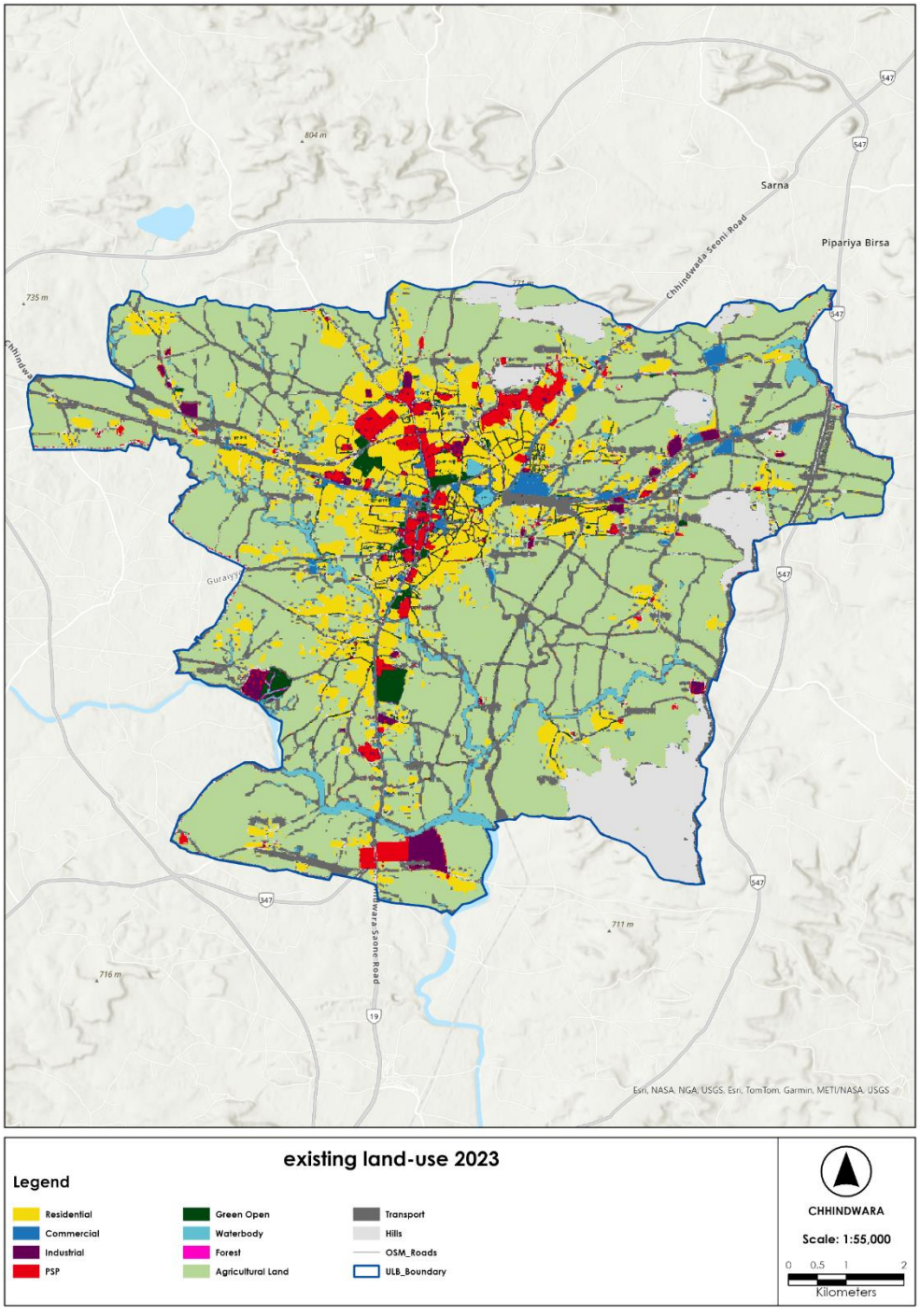


Figure 42 elu 2023

4. Slope:

The slope map classifies terrain gradients, and the analysis shows that most of the central and southern parts of Chhindwara lie within flatter zones (slope < 5%). These flatter lands are ideal for construction, infrastructure laying, and road alignment. Conversely, steeper slopes along the eastern fringe are marked unsuitable due to potential erosion, instability, and high development costs.

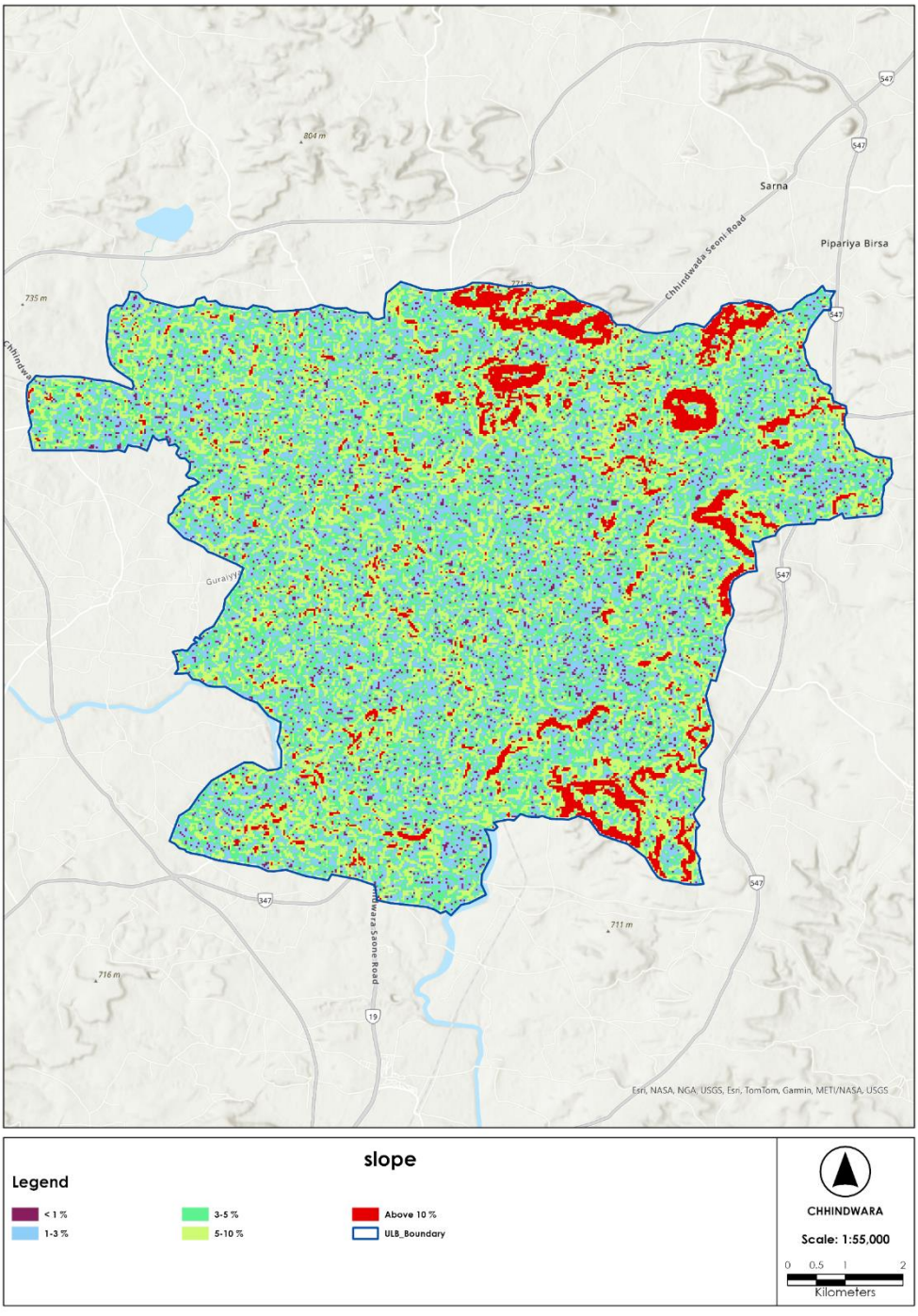


Figure 43 slope

5. Aspect:

This layer represents the directional orientation of slopes. It is particularly useful for passive design and planning considerations. North-facing and North-East-facing slopes are more favorable as they offer thermal comfort, reduced solar load, and better environmental response, making them optimal for housing clusters or institutional zones.

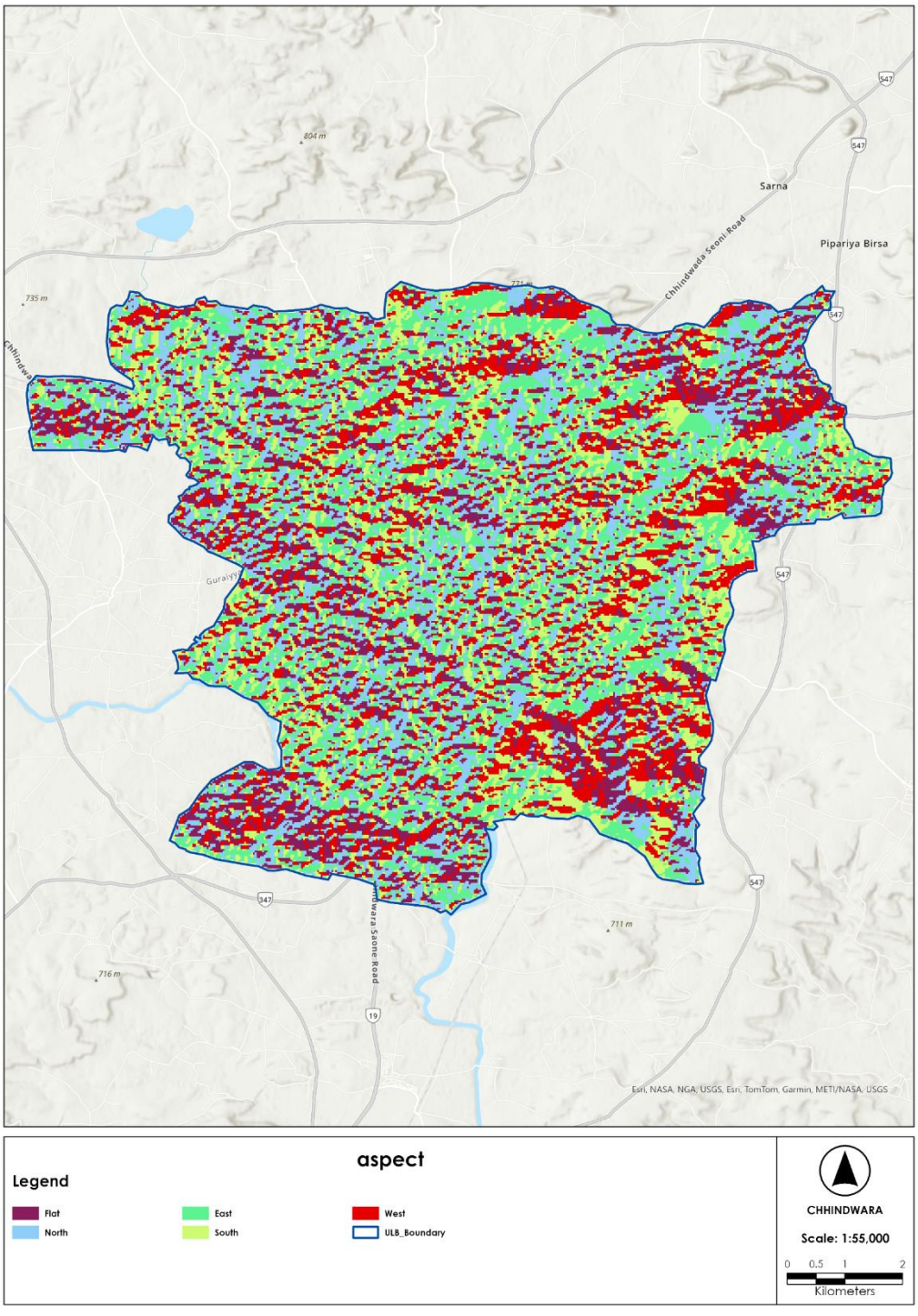


Figure 44 aspect

6. Landcover 2025:

The landcover of 2025 offers a glimpse of where urban sprawl is dense. Areas with consolidated built-up pockets adjacent to open land are noted as highly suitable due to their anchor effect—they can seed further planned development. The layer serves as a continuity base to integrate future growth with existing city form and avoid leapfrogging patterns.

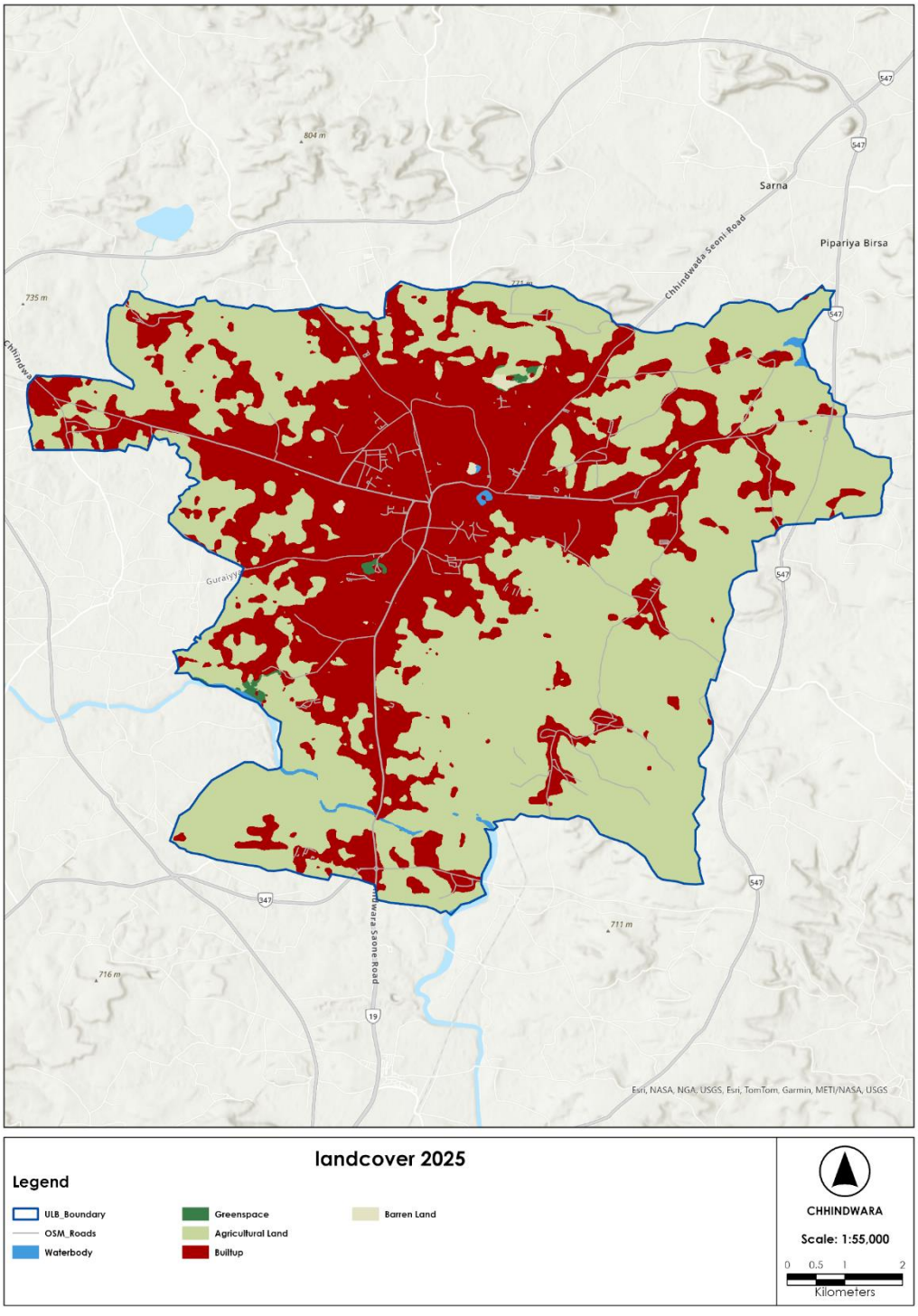


Figure 45 landcover 2025

7. Built-Up vs Open Land:

This layer clearly demarcates densely built-up areas from vacant or open lands. It helps in identifying infill potential within the existing city structure and flags open buildable areas that can be tapped for redevelopment or densification. It is a key reference layer for brownfield development.

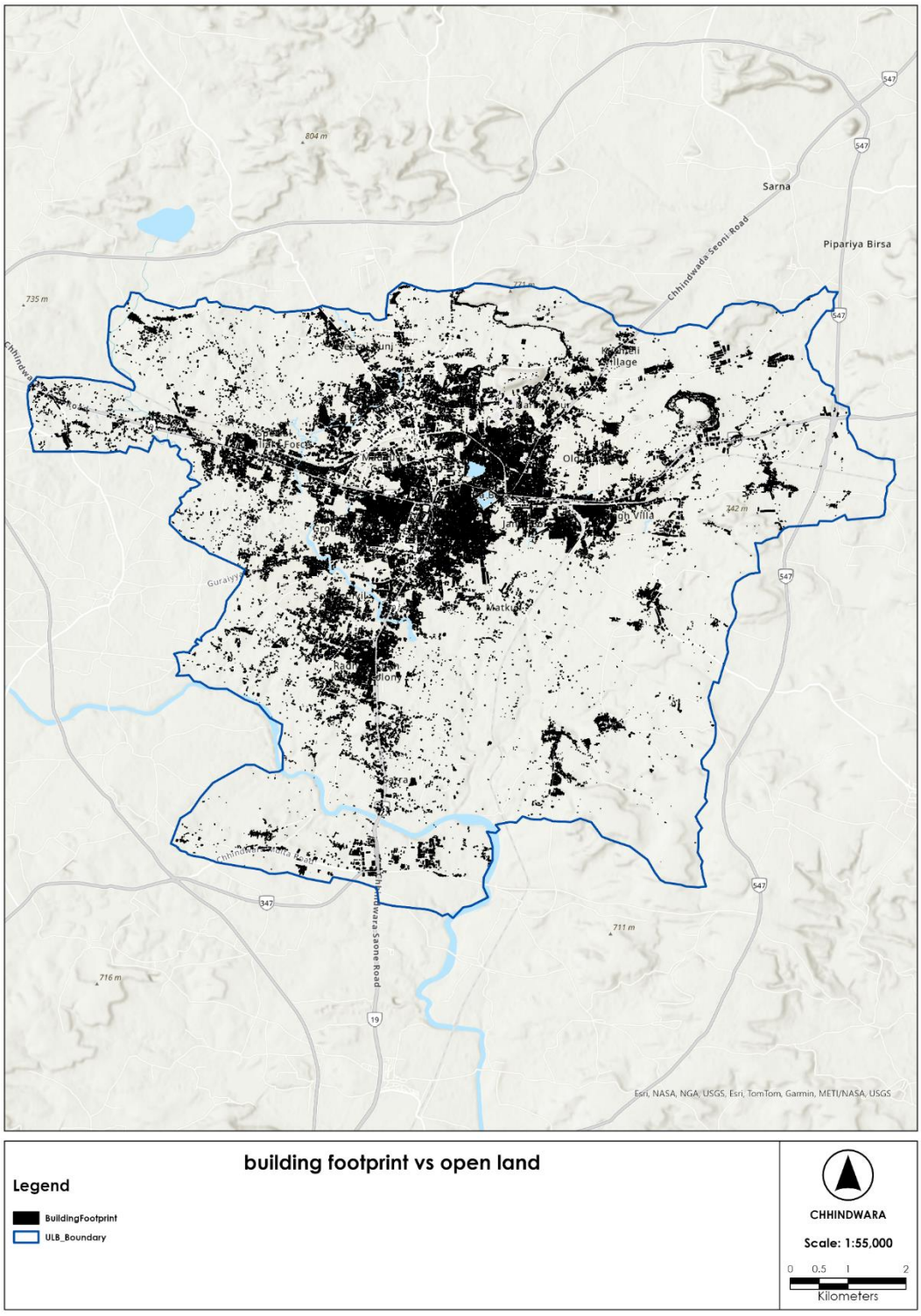


Figure 46 building footprint vs open land

8. Proximity to National Highway:

This map delineates buffer zones from major highways that traverse the district. Since national highways offer superior regional connectivity and economic access, areas closer to them are marked more suitable for industrial or commercial development. These zones benefit from transport accessibility and are prime candidates for logistics hubs or mixed-use corridors.

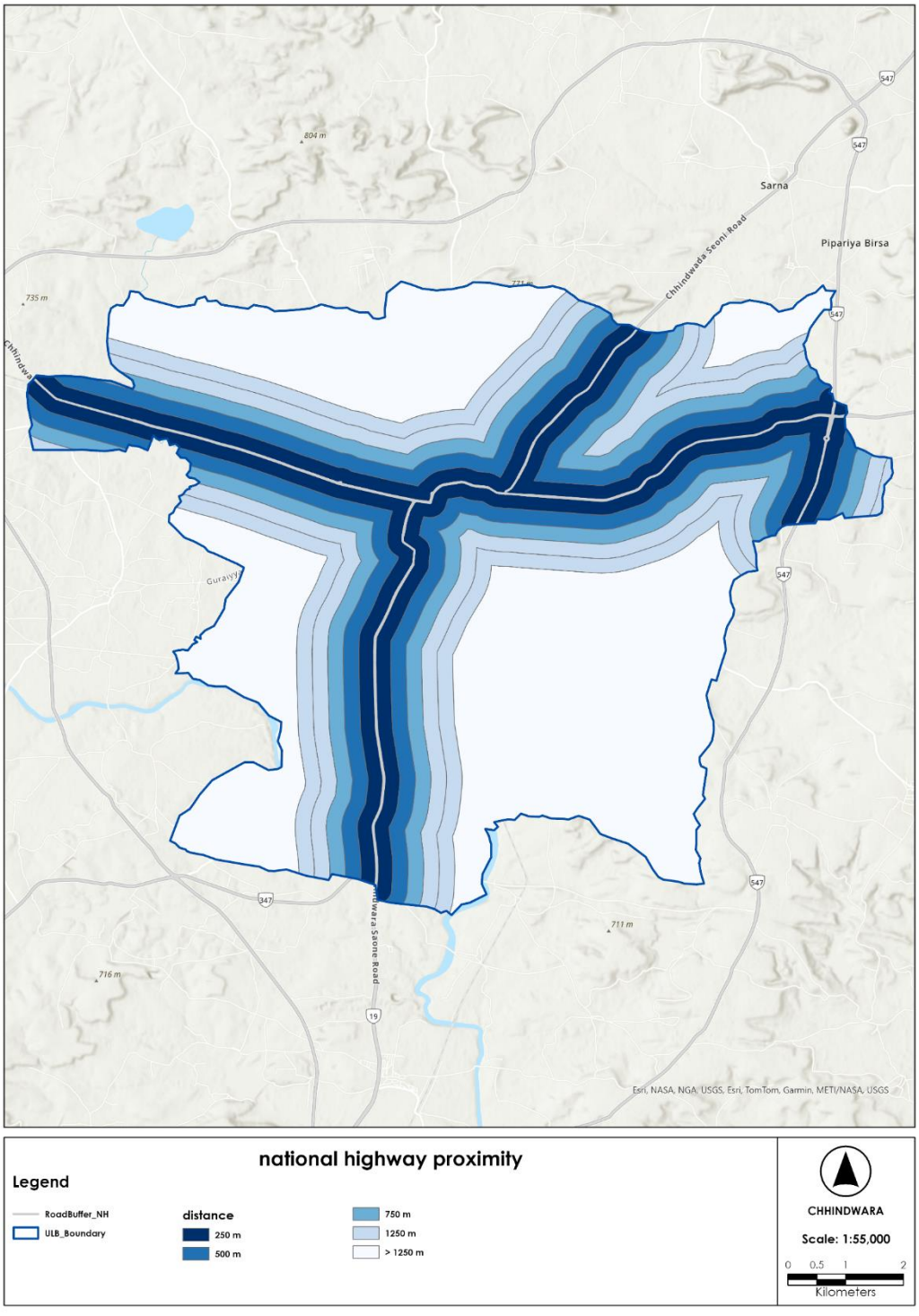


Figure 47 national highway proximity

9. Land Value:

The land value gradient shows that the core areas and plots near major highways have higher market rates, while several accessible fringe areas remain undervalued. The latter are attractive for scalable, affordable development. These zones are prioritized in the suitability index as they offer a cost-effective alternative for large-scale urban expansion.

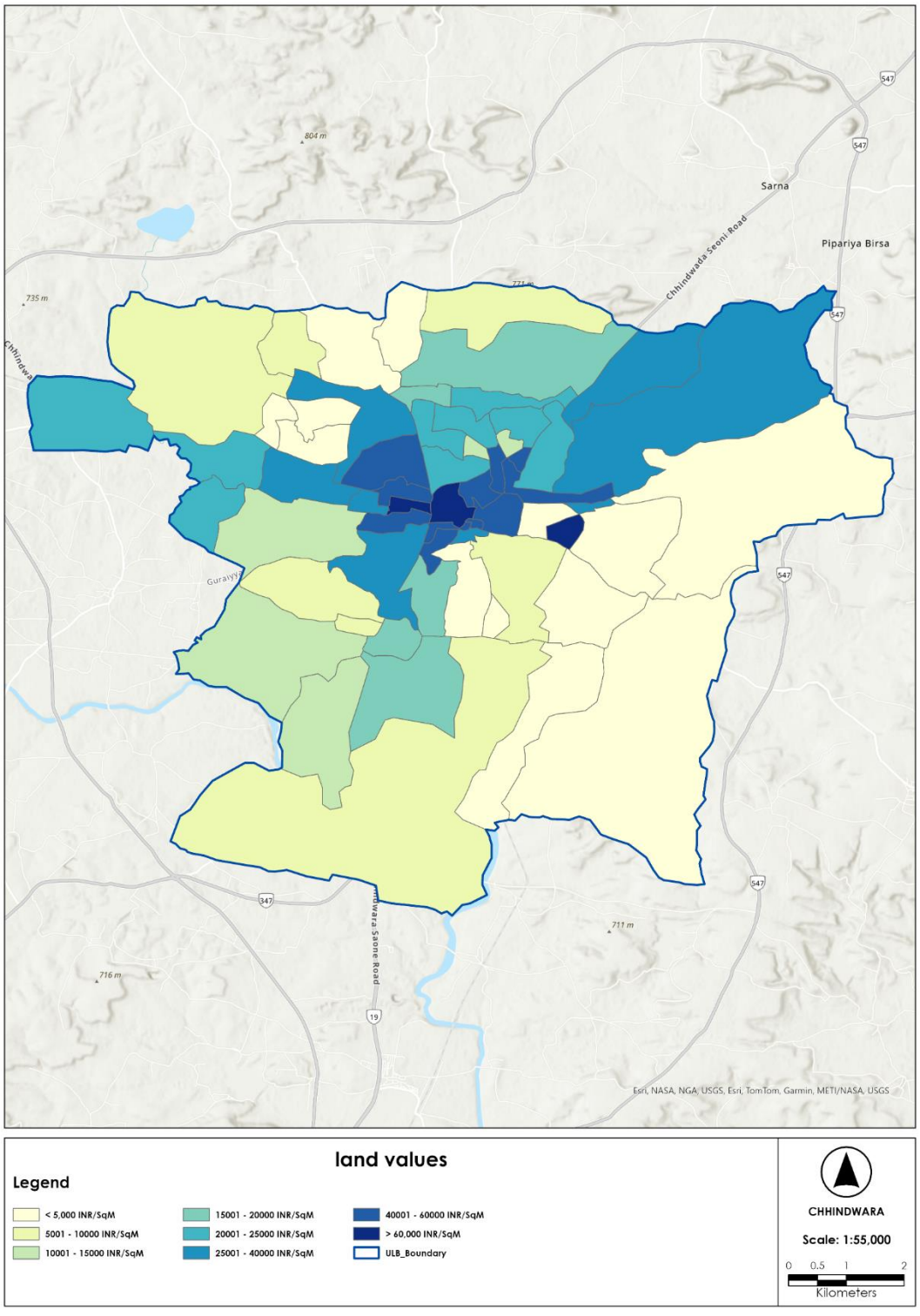


Figure 48 land values

10. Proximity to State Highways:

Similar to national highway buffers, this layer analyzes proximity to state highways. Regions near these corridors are favorable due to better potential for inter-town linkage, freight routes, and strategic growth. These corridors are important for developing new urban centres and satellite townships.

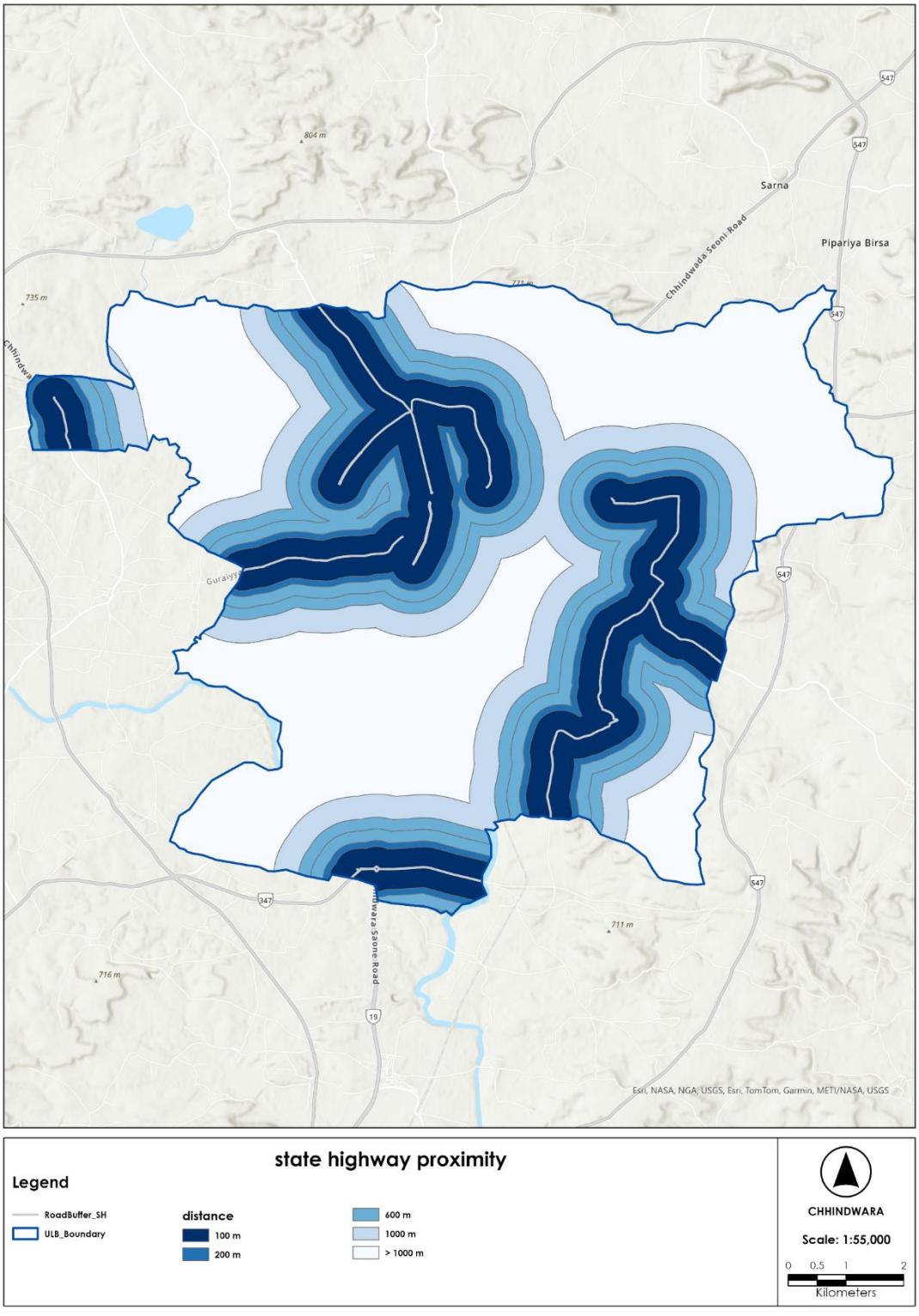


Figure 49 state hioghway proximity

11. Proximity to Proposed Roads (2035):

Future connectivity plans are integrated through this layer. It highlights areas expected to be well-connected under the proposed 2035 road network. These are critical growth anchors and guide decisions about where to locate new residential, commercial, and institutional zones. This proactive mapping supports transit-oriented and planned expansion.

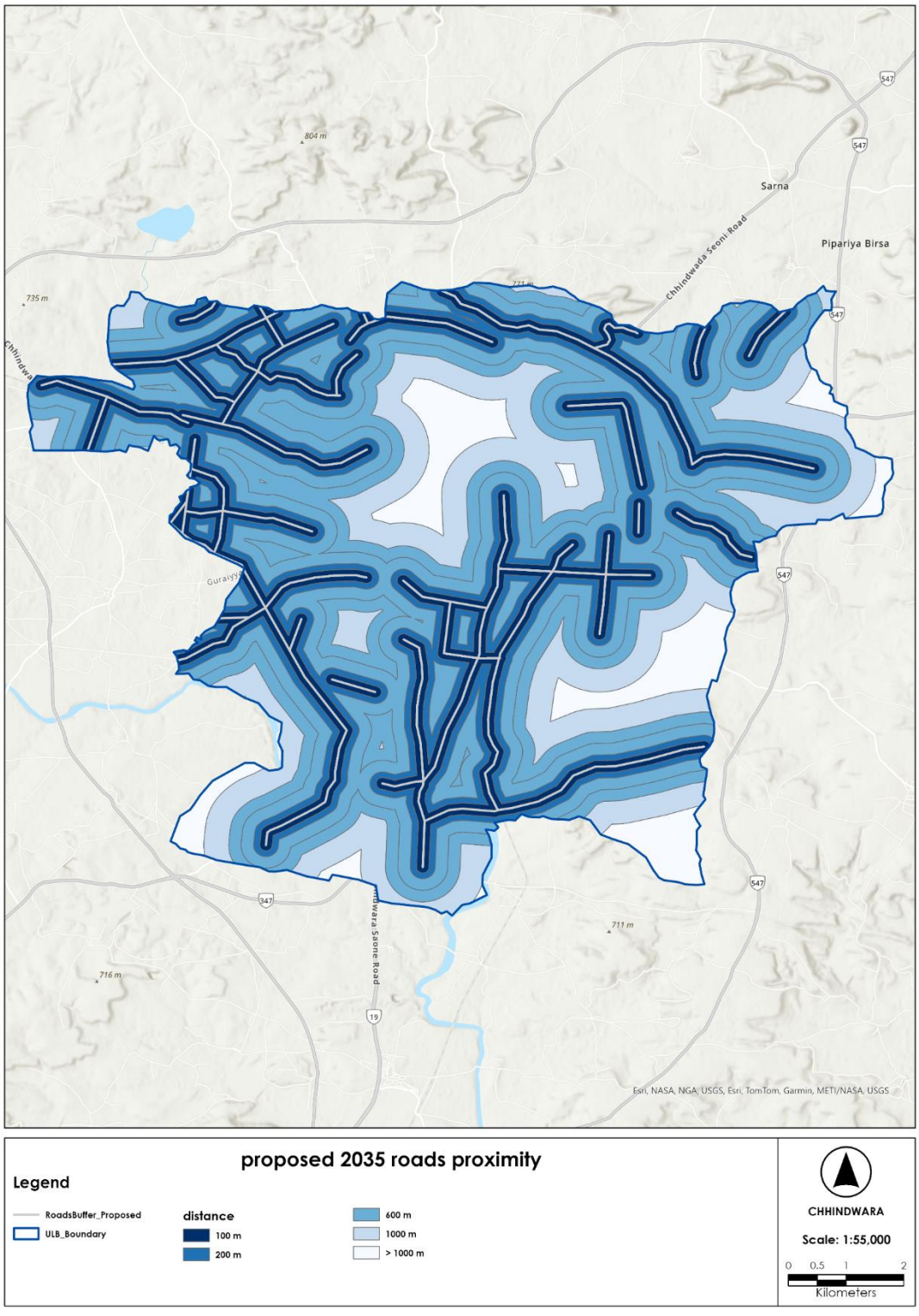


Figure 50 proposed roads proximity 2035

12. Projected Urban Sprawl (2040):

This simulation layer, derived from the Cellular Automata model, shows where uncontrolled sprawl is most likely to occur by 2040. It is used as a constraint and validation layer in the suitability model—areas projected to experience haphazard sprawl are de-prioritized, while those with potential for structured, contiguous growth are preferred. This helps in minimizing future disintegration and infrastructure mismatch.

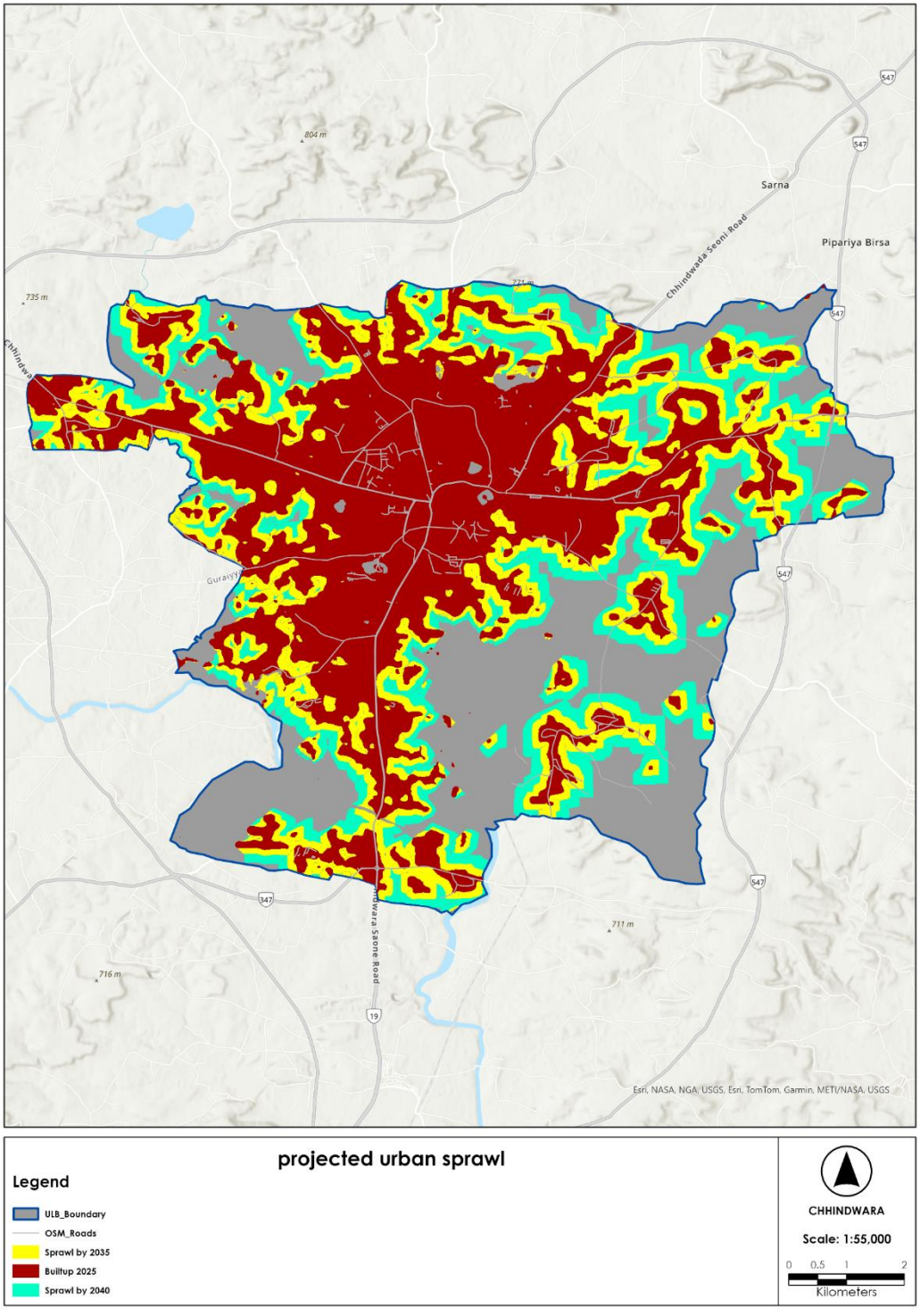


Figure 51 projected urban sprawl

8.3 Land Suitability Index

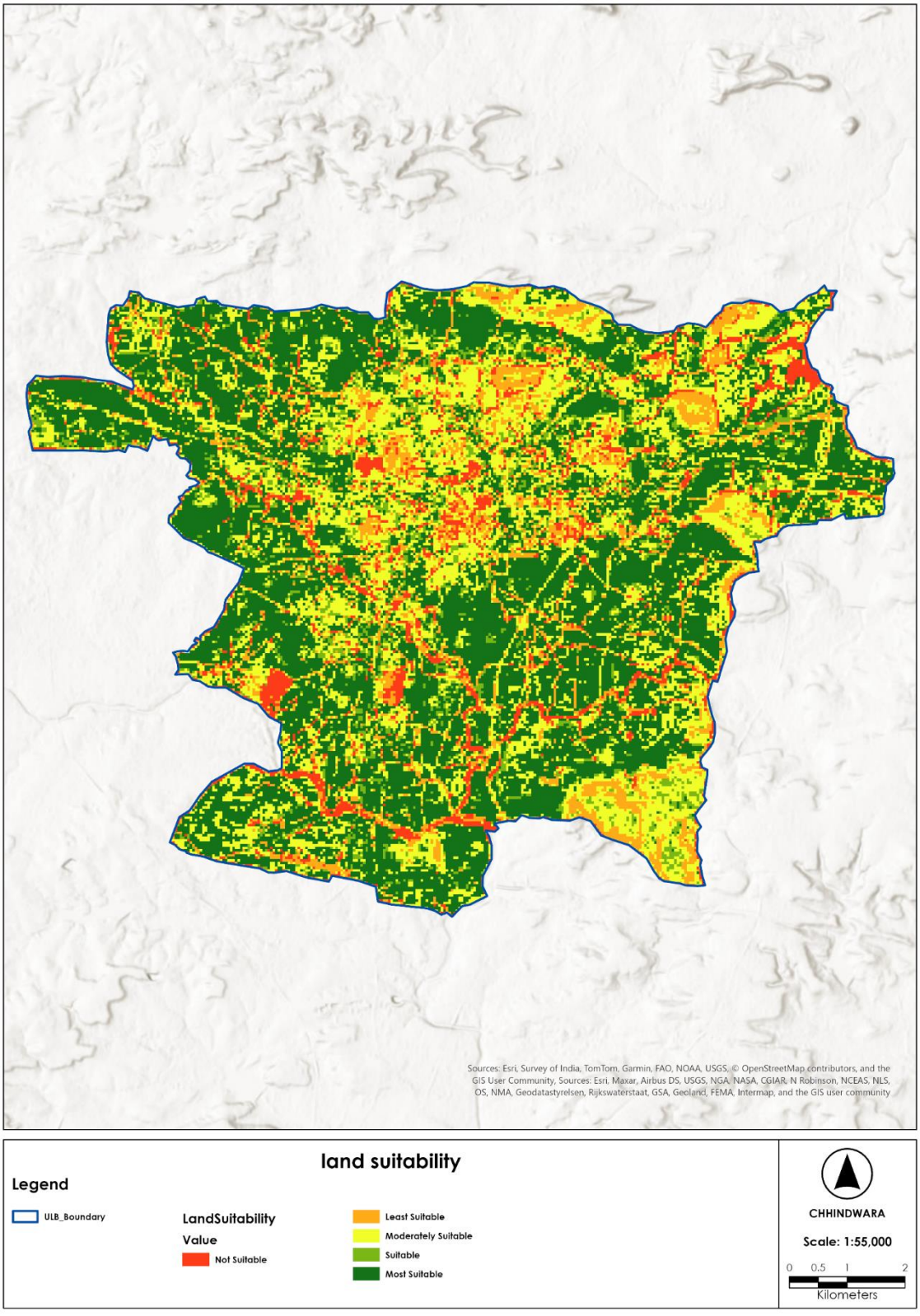

land suitability
Legend
ULB_Boundary
LandSuitability
Value
Not Suitable
Least Suitable
Moderately Suitable
Suitable
Most Suitable
CHHINDWARA
Scale: 1:55,000
0 0.5 1 2
Kilometers
Sources: Esri, Survey of India, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Sources: Esri, Maxar, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap, and the GIS user community

Figure 52 land suitability

Final Land Suitability Index Output

The composite Land Suitability Index (LSI) map represents the outcome of a multi-criteria overlay analysis combining 13 spatial parameters that affect urban development feasibility in Chhindwara. Each raster input layer—such as parcel size, slope, proximity to highways, land use, and projected sprawl—was weighted based on planning relevance and standardized into a unified scoring framework. The final index helps spatially categorize the city's developable zones into four distinct classes.

Key Takeaways from Suitability Classification

1. **Most Suitable Zones (Green)**:
   These areas dominate the southern and southeastern peri-urban belts of Chhindwara. They score highly across multiple parameters due to:
   - **Gentle topography (<5% slope)**
   - **Larger and contiguous land parcels**, easing implementation of Land Readjustment or TPS
   - **Low environmental sensitivity**, with minimal interference from waterbodies or hazard zones
   - **High accessibility**, being close to major roads, proposed corridors, and future urban expansion fronts

These locations are optimal for **guided urban development**, particularly Area-Based Development (ABD) planning, as they allow cost-effective infrastructure roll-out and support mixed-use zoning.

2. **Moderately Suitable Zones (Yellow)**:
   Found in parts of the west and northeast, these areas show:
   - Moderate constraints such as smaller landholdings or medium slope
   - Limited but improvable access to road infrastructure
   - Adjacency to transition zones between rural and urban land use

Although not ideal in their current form, these areas **can be integrated** into the development grid through targeted infrastructure investments and restructuring—making them secondary candidates for phased urban growth.

3. **Least Suitable Zones (Orange)**:
   These are mostly scattered pockets marked by:
   - Terrain irregularities like steep slopes (>5%), or

- Ecological features such as drainage buffers and forest edges
- Highly fragmented ownership or lack of development triggers

They pose **technical or economic challenges** to development and are better reserved for **low-impact functions** like public greens, institutional campuses, or open space buffers. Where needed, these can be reconsidered only after significant groundwork or through government-led land consolidation.

4. **Not Suitable Zones (Red)**:
   These areas fall under critical constraints and should be **excluded from urban expansion**. They include:
   - Natural water drains and riparian zones
   - Core urban areas already saturated with dense built-up
   - Zones with high ecological value or natural hazards

These zones are **structurally unfit** for further construction and should instead be preserved as **ecological buffers, green wedges, or urban open spaces**, supporting environmental sustainability.

Overlay Methodology Summary

- A total of **13 thematic layers** were compiled using raster analysis in GIS.
- The **highest weights** were assigned to key expansion factors like **parcel size (40%)** and **existing land use (40%)**.
- Other important but supporting factors like **slope**, **aspect**, **road proximity**, and **land value** were weighted between 10–20%.
- **Weighted sum overlay** was then performed to compute a pixel-level suitability score.
- The result was reclassified into four categories—**Most Suitable, Suitable, Least Suitable, and Not Suitable**.

This final Land Suitability Index map will guide **site selection for planning interventions**, ensuring that urban growth is **ecologically sensitive, economically viable, and spatially integrated**. It directly informs further proposals such as ABD zone delineation, infrastructure prioritization, and land readjustment-based development.

S.NO.	THEME	THEME WEIGHT	CLASS	CLASS WEIGHT
1	LAND PARCEL SIZE	40	< 2500 sqft	2
2			2500 - 5000 sqft	3
3			5000 - 7500 sqft	4
4			> 7500 sqft	5
5			City Core	1
1	NATURAL WATER-DRAIN	10	Stream buffer	3
2			Drain	1
3			Non-drain	5
1	EXISTING LAND-USE	40	Residential	3
2			commercial	3
3			industrial	3
4			psp	2
5			green open	1
6			waterbody	1
7			forest	2
8			agricultural land	5
9			transport	4
10			hills	1
1	SLOPE	20	< 1 %	5
2			1 - 3%	4
3			3 - 5 %	3
4			5 - 10 %	2
5			Above 10 %	1
1	ASPECT	10	Flat	5
2			North	4
3			East	3
4			South	2
5			West	1
1	LAND COVER 2025	30	Builtup	2
2			Waterbody	3
3			green open	1
4			agricultural land	4
5			Barrenland	5
1	BUILDING FOOTPRINT VS OPEN LAND	10	Builtup	1
2			Open Land	5
1	PROXIMITY TO NH	20	250 m	5
2			500 m	4
3			750 m	3
4			1250 m	2
5			> 1250 m	1
1	PROXIMITY TO SH	10	100 m	5
2			200 m	4
3			600 m	3
4			1000 m	2
5			> 1000 m	1
1	PROXIMITY TO PROPOSED 2035 ROADS	20	100 m	5
2			200 m	4
3			600 m	3
4			1000 m	2
5			> 1000 m	1
1	LAND VALUE	30	< 5000 INR/SqM	5
2			5000 - 10000 INR/SqM	5
3			10000 - 15000 INR/SqM	4
4			15000 - 20000 INR/SqM	4
5			20000 - 25000 INR/SqM	3
6			25000 - 40000 INR/SqM	3
7			40000 - 60000 INR/SqM	2
8			> 60000 INR/SqM	1
1	PROJECTED URBAN SPRAWL	20	Builtup 2025	1
2			Sprawl by 2035	5
3			Sprawl by 2040	3

Table 23 class weight for overlay analysis

Figure 53 layer weight for overlay analysis

Chapter – 9

Proposals & Recommendations

9.1 Schematic Road Network

This **schematic road network** forms the **foundational layer** of the proposed **mobility improvement strategy** for Chhindwara. The map illustrates the **existing urban fabric** in relation to **major road infrastructure**, including both **current primary corridors** and the city's **radial connectivity**.

Key intersections such as **Rani Durgawati Chowk**, **Raja Bhoj Statue**, **Chaar Fatak**, and **CSM Tiraha** have been marked to highlight **critical urban nodes**. These junctions serve as **major convergence points** for intra-city and peripheral movement. However, many of them currently suffer from **congestion**, **poorly managed intersections**, and **limited capacity** for future growth.

The schematic view brings forward the **spatial structure** of Chhindwara's growth, showing how **existing major roads** carve through the **dense urban core** and **peri-urban extents**. This sets the base for identifying **missing links**, potential **ring road completions**, and **bypass alignments** to redistribute traffic and reduce pressure on **saturated urban junctions**.

By mapping these **critical movement corridors** and **activity nodes**, the schematic layout facilitates a **phased and logical augmentation** of the network, integrating **future connectivity** with **development planning**.

This map highlights the **current limitations** in Chhindwara's **road network hierarchy**, particularly when comparing **major versus minor road coverage**. Although **good accessibility** exists along the **primary highways**, connectivity rapidly weakens as one moves toward the **inner and outer peri-urban belts**. This creates **uneven accessibility gradients**, leaving several regions poorly connected and **underutilized**.

A key observation is the **absence of an inner concentric circulation road**, which is critical for **intra-city movement**. Without such a structure, **traffic distribution** remains radial and bottlenecked at key intersections, increasing pressure on the **existing central spine** of roads.

Furthermore, there are **large chunks of southern and eastern peri-urban land** that

completely lack any road infrastructure, making them **inaccessible** for development despite being **geographically strategic**. This has contributed to **imbalanced urban expansion** and **wasted potential** in terms of land use.

The presence of **dead-end roads** in many minor stretches also reflects **unplanned, fragmented development**, which hinders circulation and poses challenges for services like public transport, waste collection, and emergency access.

This diagnosis provides a strong rationale for proposing a **coherent, hierarchical road structure** that improves **connectivity**, introduces **concentric bypasses**, and resolves **infrastructure gaps** to support structured urban expansion.

The proposed road network introduces a **hierarchical circulation system** aimed at resolving the issues identified in the existing layout and enabling **structured urban growth**. This schematic integrates **new primary, secondary, and tertiary roads**, systematically layered to improve **connectivity**, **access**, and **land readiness**.

A major intervention is the introduction of a **30-meter-wide Inner Ring Road**, forming a **concentric circulation spine** around the urban core. This addresses the previously identified absence of inner connectivity and reduces dependency on the central radial roads. It also redistributes traffic, enhancing **intra-city mobility**.

24-meter-wide arterial roads branch out from the ring and extend across the **underutilized southern and southeastern peri-urban regions**, stitching disconnected land parcels into the urban framework. These corridors act as **future public transport routes** and are designed to support **mixed-use development**, catalyzing densification in targeted zones.

18-meter and 12-meter collector roads form a **gridiron layout**, subdividing large greenfield parcels for efficient **land pooling** and enabling future implementation of **Town Planning Schemes (TPS)**. This facilitates **zoning**, simplifies land readjustment, and ensures equitable infrastructure provisioning across new urban extensions.

By proactively embedding roads into **low-slope, high-suitability zones**, the network prepares the peri-urban fabric for **planned expansion**, while respecting environmental constraints. The design also eliminates abrupt dead ends and ensures **looped connectivity**, addressing key spatial inefficiencies seen in the current network.

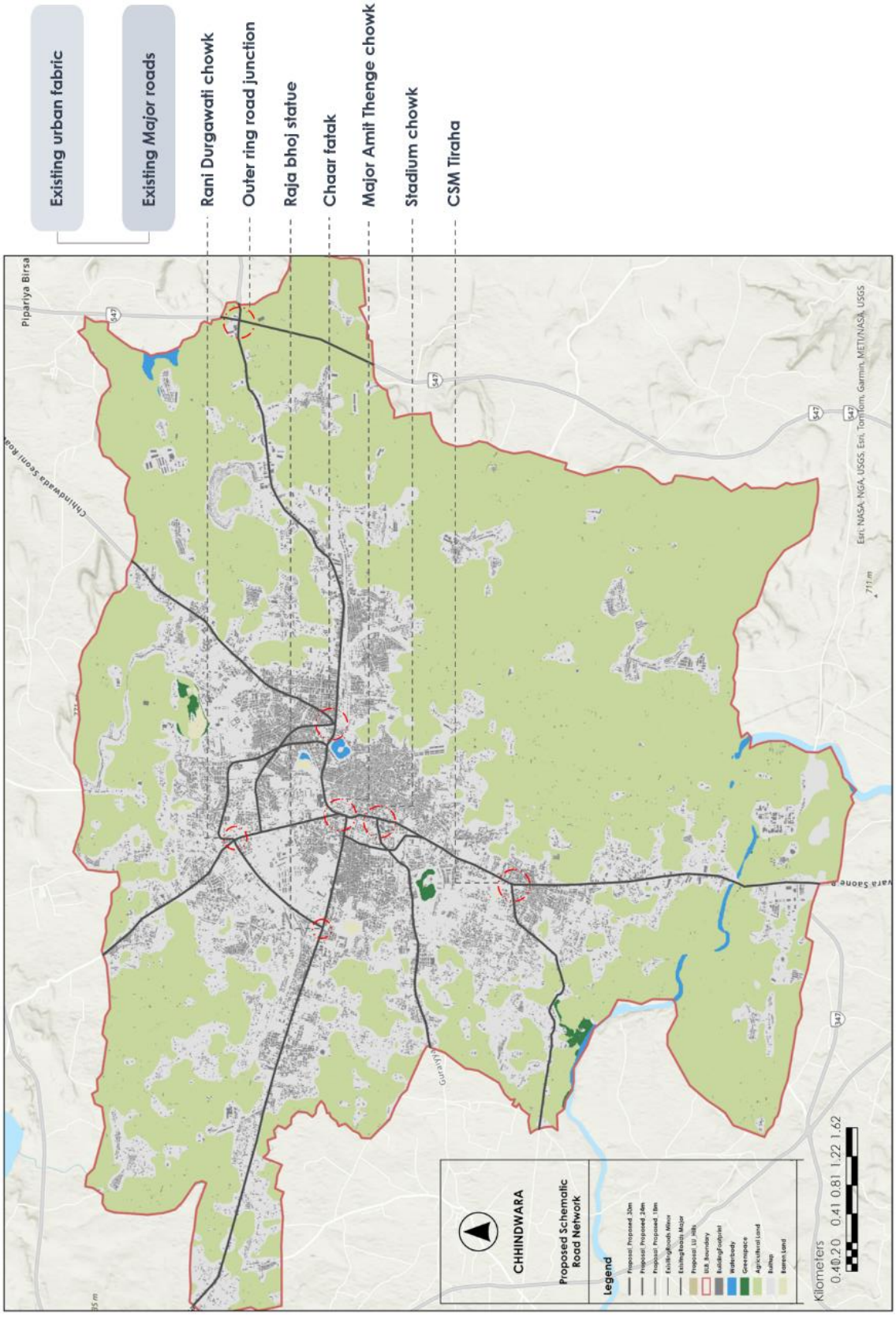
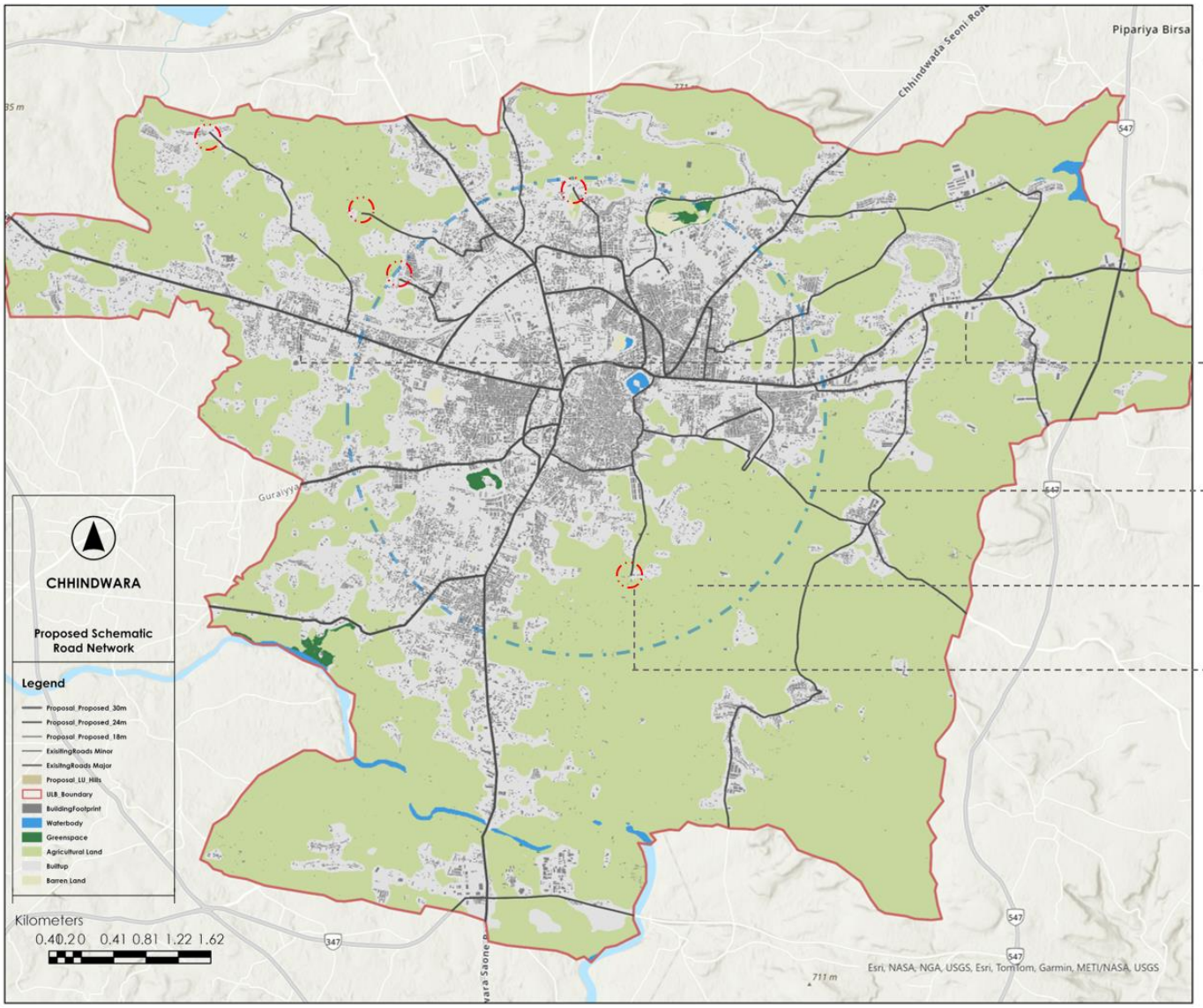


Figure 54 exisitng roads and major junctions

Figure 55 exisiting roads scenario



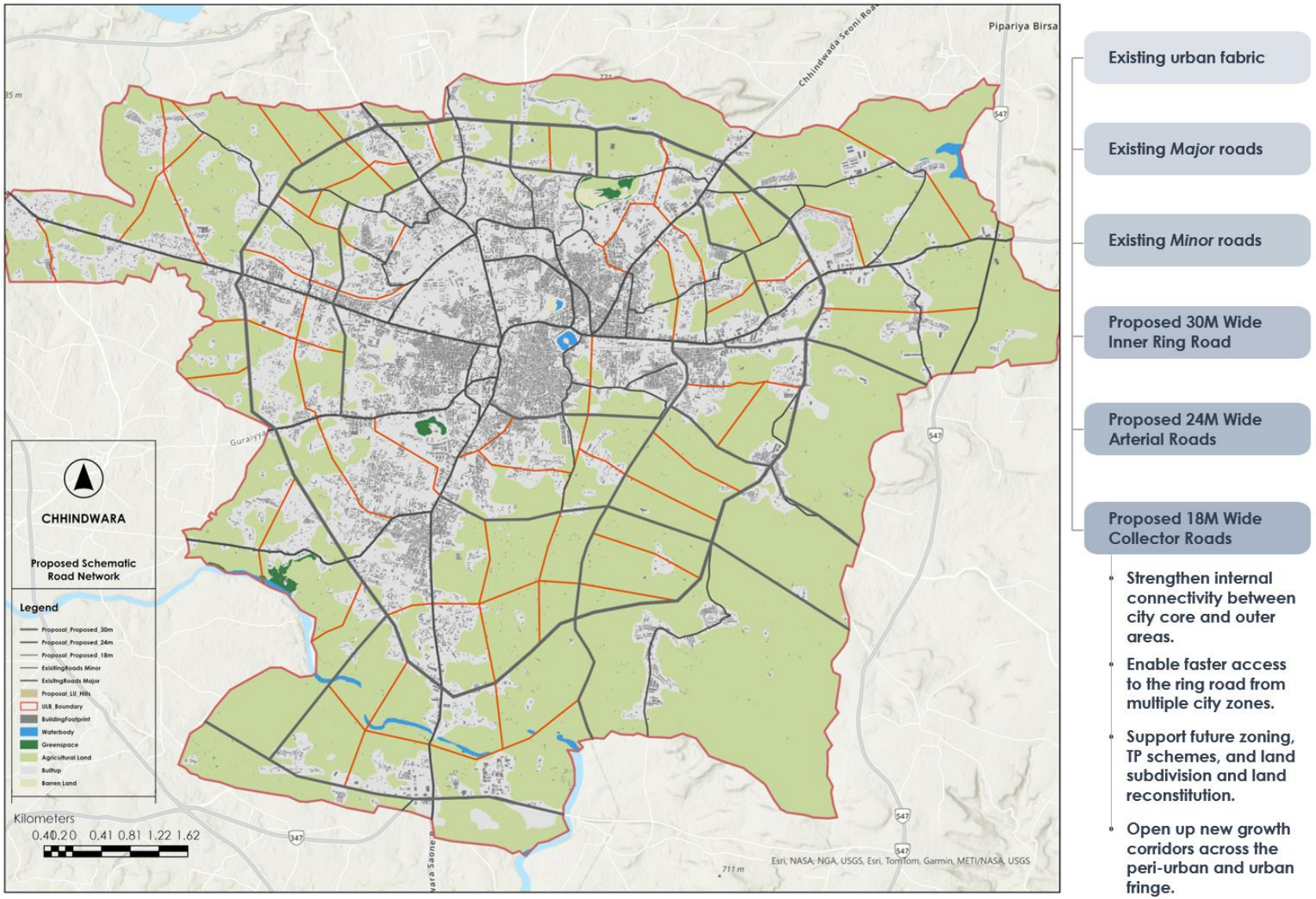


Figure 56 propsed roads 01

The schematic road network proposal for Chhindwara presents a **strategic framework to guide structured urban growth**, especially in the underutilized peri-urban zones. It addresses major issues observed in the current road system, such as **radial dominance**, **lack of concentric connectivity**, and **dead-end linkages** in expanding areas.

The backbone of this network is a newly introduced **30-meter-wide Inner Ring Road**, forming a **concentric circulation loop** around the urban core. This road is designed to **decongest inner-city junctions**, provide **alternate routing options**, and improve connectivity across major radial corridors.

To support outward expansion, a tiered system of **24-meter-wide Arterial Roads** and **18-meter-wide Collector Roads** is proposed, predominantly in the **southern and eastern greenfield areas**. These corridors are aligned with **land suitability analysis outputs** and follow a **grid-based geometry** to facilitate **Town Planning Scheme (TPS) implementation** and future zoning exercises.

In addition, **12-meter-wide minor collectors** penetrate deeper into fragmented parcels, aiming to **regularize internal access**, enable **plot reconstitution**, and prepare peripheral belts for **future urbanization**.

The proposed network follows **three key planning principles**:

1. **Unlocking land potential**: By inserting a rational road hierarchy in currently inaccessible zones, the plan enables future land use zoning, infrastructure provisioning, and private-sector development.
2. **Supporting equity and balance**: Peripheral areas often remain excluded from development due to poor connectivity. This framework ensures **balanced city expansion** and more equitable distribution of investments.
3. **Future-proofing for mobility**: The structure is designed with **multi-modal readiness**, allowing for future BRT corridors or ring bus services, and reinforcing a robust, **hierarchical transit-supportive layout**.

Together, these interventions transform Chhindwara's radial-only form into a **multi-nodal, grid-integrated circulation system** that is **functionally efficient**, **spatially inclusive**, and ready to support **planned urban growth** over the next two decades.

Figure 57 Proposed schematic road network

9.2 Schematic ABD LandUse Zoning

Delineation of ABD Area for Land-Use Zoning

The proposed **Area-Based Development (ABD)** zone has been carefully delineated in the **southeastern peri-urban tract of Chhindwara**, encompassing a total area of **12.62 sq. km**. This region has been selected as a **strategic growth hub** based on a combination of **land suitability analysis**, **accessibility improvements**, and **existing infrastructure potential**.

Located adjacent to the city's established urban core, the delineated ABD zone sits within the newly proposed **schematic road network**, allowing for **seamless integration** with both existing urban fabric and future expansion areas. The area has been logically subdivided into **rectilinear blocks** using the proposed grid-based circulation system, which not only aligns with **Town Planning Scheme (TPS)** principles but also facilitates **plot reconstitution**, **land pooling**, and **phased zoning applications**.

Key considerations in delineating this ABD zone include:

- **Proximity to existing city core**: Ensures that the ABD builds upon current urban infrastructure and doesn't develop in isolation.
- **Flat and development-ready terrain**: Most of the ABD area falls within **low-slope, non-ecologically sensitive greenfield lands**, as per the Land Suitability Index.
- **Potential for economic activation**: The area is well-positioned to accommodate new economic activities, especially agro-processing, light industries, and ethnobotanical-based clusters, leveraging its **peri-urban character**.
- **Scalability and flexibility**: The size and layout of the ABD zone allow for **scalable implementation**, adaptable to varying land use intensities, plot ownership patterns, and phased development strategies.

Figure 58 ABD area delineation

01. Industrial Land-Use (Purple) – 9.2%

- **Zone A**, located on the **southern fringe** abutting the railway line, is earmarked for **ethnomedicinal and agro-processing industries**, leveraging freight accessibility and reducing urban conflict.
- **Zone B** is conceived as a **planned extension of Chhindwara's existing industrial area**, supporting employment continuity in the manufacturing sector and formalizing the region's herbal market economy.

---

02. Commercial Land-Use (Blue) – 5%

- Located along **24m arterial corridors and focal junctions**, these zones are planned to foster **retail, trade, and service economies**.
- Functions include **showrooms, malls, retail offices, and urban market corridors**.
- A key **regional commercial hub** is proposed at the intersection of the ring road and Nagpur highway, acting as a highway-oriented growth magnet.

---

03. Public & Semi-Public Land-Use (Red) – 11.8%

- Strategically integrated with the commercial zone, this land use forms a **secondary CBD** and supports a mix of **institutional and civic infrastructure**.
- Allocated for **schools, colleges, hospitals, administrative offices, and public halls**, these areas form the **social spine** of the ABD.
- A plot near the **Kulbehra River** is reserved for a **Sewage Treatment Plant**, promoting sustainability.

---

04. Transport Land-Use (Grey) – 1%

- Two dedicated transport hubs are planned:
    - One at the junction of the proposed **ring road and Seoni highway** to support intercity movement.
    - Another along the **railway and industrial edge**, creating an **efficient freight logistics hub** for agro-industrial goods.

---

05. Mixed-Use Residential R1 Land-Use (Orange) – 18%

- Oriented along **24m arterial roads**, these zones blend **residential and commercial functions** to promote **transit-supportive development**.
- They maximize **infrastructure utility**, foster economic vibrancy, and ensure that residents live close to workplaces and services.

---

06. General Residential R2 Land-Use (Yellow) – 30%

- Forming the **largest share of the ABD**, these zones are designed for **low-density, family-oriented housing**.
- The layout allows for **courtyards, green open spaces**, and clear demarcation of private living areas, creating **livable and community-driven neighborhoods**.

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07. Recreational Land-Use (Green) – 14%

- Strategically placed as **buffers and along natural features**, recreational spaces improve **microclimate**, enhance **resilience**, and contribute to **health and wellness**.
- These zones double as **gathering areas and urban lungs**, helping reduce congestion while improving quality of life.

Together, this schematic land use plan presents a **balanced, inclusive, and economically progressive development model**, integrating traditional economies with new urban planning paradigms. Each land use category plays a critical role in achieving **functional synergy**, **environmental sustainability**, and **regional economic transformation** for Chhindwara.

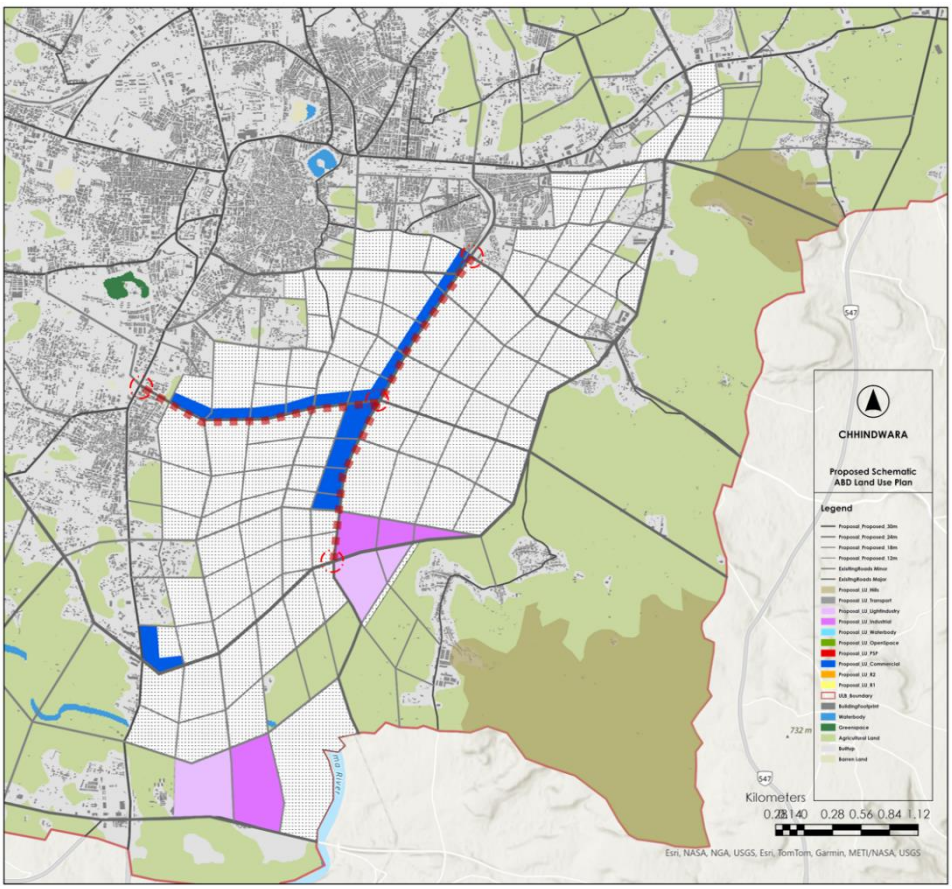

Figure 60 landuse commercial

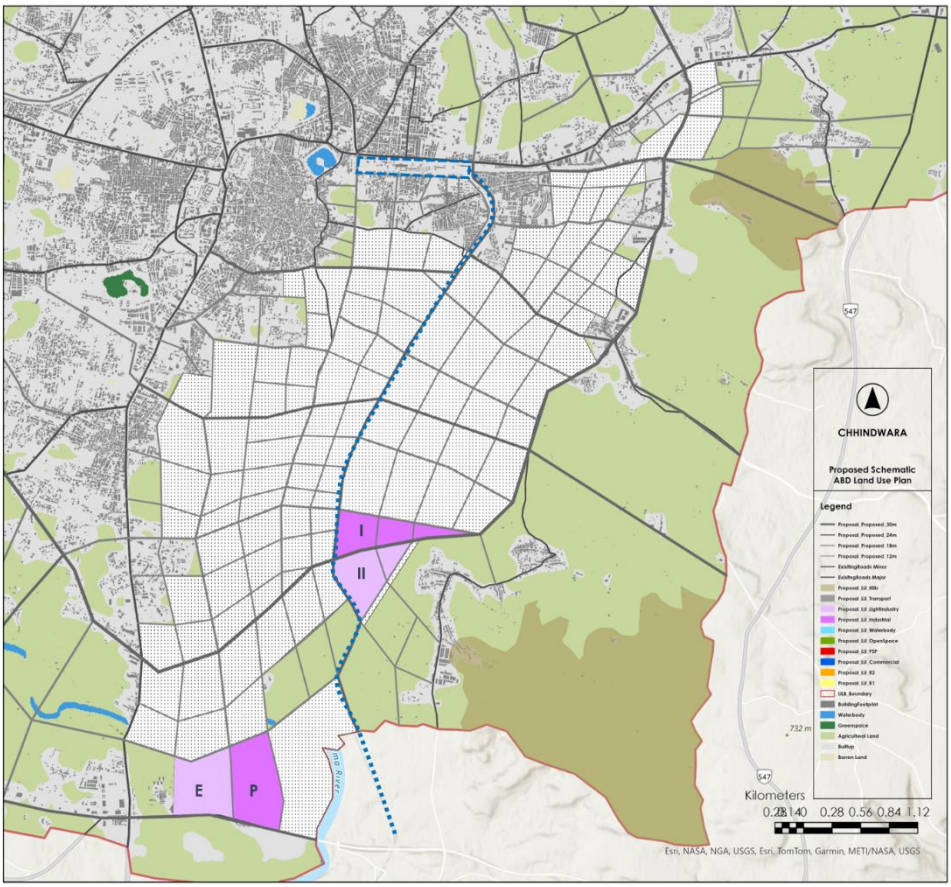

Figure 59 landuse industrial

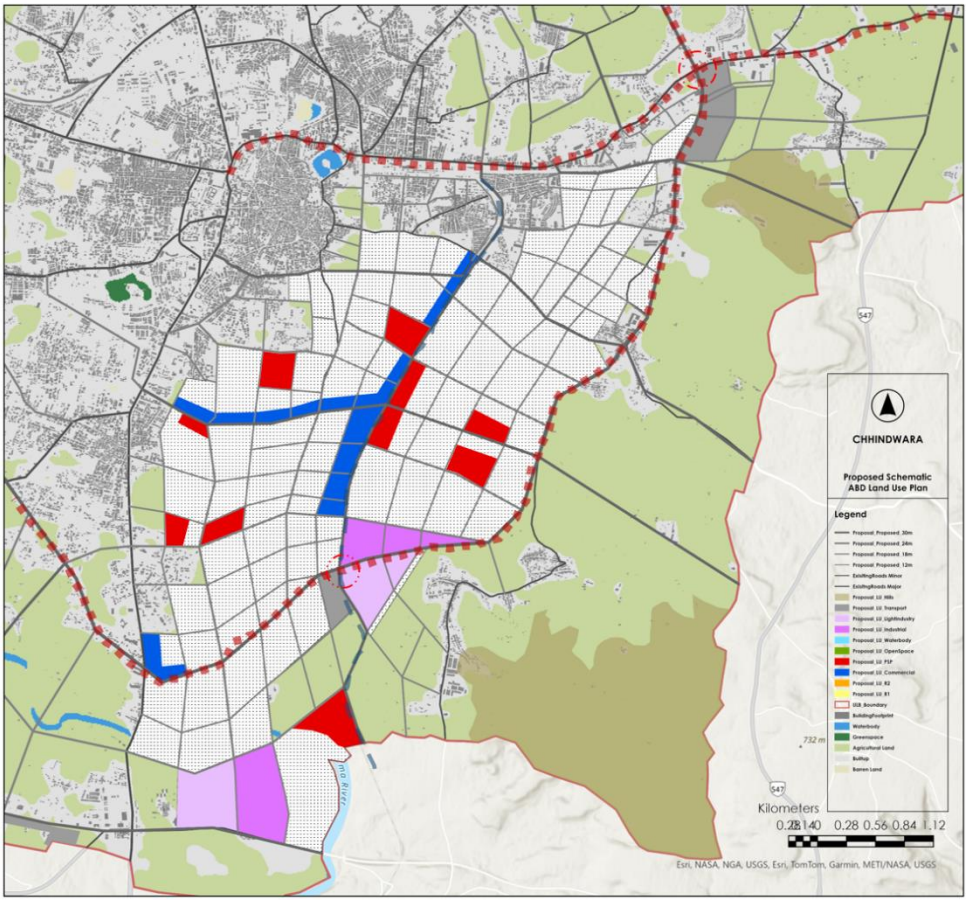

Figure 62 landuse PSP

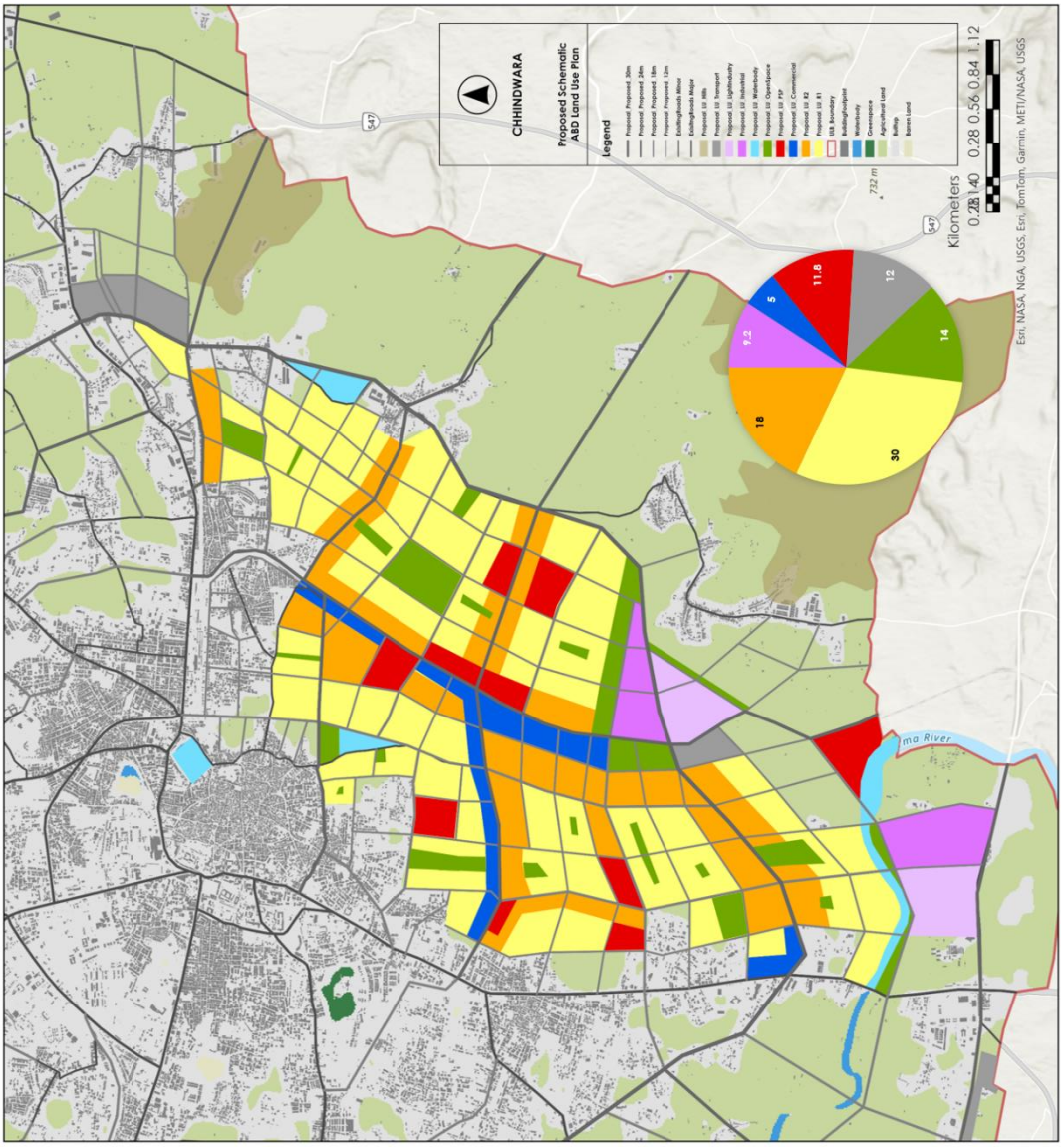

Figure 63 Proposed ABD landuse plan

9.3 TP Schemes Delineation

To ensure **phased, regulated urban expansion** in the ABD zone of Chhindwara, a **Town Planning Scheme-based strategy** has been adopted. The area is divided into **15 TP schemes**, grouped under three implementation phases based on **existing development levels**, **infrastructure stress**, and **land availability**. This sequencing ensures **balanced urbanization**, infrastructure readiness, and equitable land development over time.

---

01. Phase I – Red (High-Priority Zones)

- Located near the **urban fringe** with up to **40% built-up area**, these sectors are under **high development pressure**.
- This phase requires **early intervention** to avoid **unplanned fringe growth** and to establish **basic infrastructure and services** swiftly.
- It functions as a **transition zone** connecting the **old city core** to the new ABD zone, facilitating **smooth spatial integration**.
- Given the **existing population and utility coverage**, Phase I is best suited for **initial implementation and early land pooling** efforts.

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02. Phase II – Blue (Mid-Term Development Zones)

- Comprises plots with around **20% existing development**, primarily accommodating **commercial and public-semi-public uses**.
- Positioned for **medium-term implementation**, these areas serve as a **logical extension** of Phase I development.
- This phase allows the **gradual rollout of road infrastructure**, zoning regulations, and utility expansion, minimizing disruption to active land use.
- Phase II serves as a **buffer zone**, maintaining **urban growth momentum** while allowing time for private investment readiness.

---

03. Phase III – Pink (Future Growth Zones)

- Composed of **greenfield sites** with under **10% built-up presence**, largely consisting of **agricultural and undeveloped lands**.
- Meant for **long-term expansion**, Phase III zones are reserved to host **future residential clusters, industrial nodes, and institutional complexes** as the city's

population and economy grow.

- These areas are preserved for **structured urbanization** post-Phase II, ensuring the city avoids premature or fragmented development.
- The approach supports **orderly outward growth** while protecting natural/agricultural buffers and allowing strategic land acquisition planning.

This **phased TP scheme layout** builds a strong foundation for **land reconstitution**, road and zoning integration, and guided public-private development partnerships. It also aligns closely with the proposed road network and ABD land use structure, making it a **holistic tool for managing peri-urban transformation** in Chhindwara.

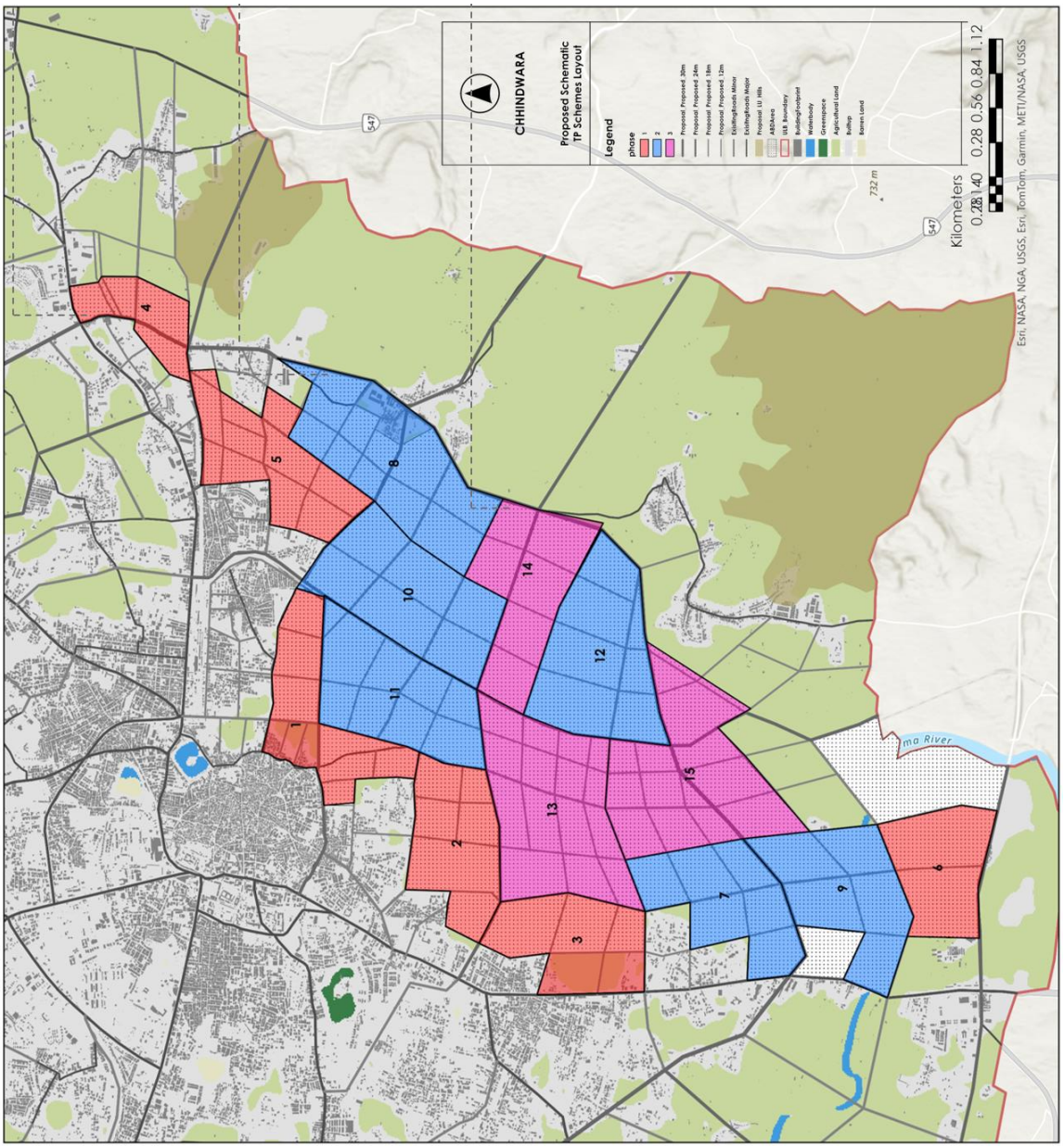


Figure 64 Proposed TP schemes delineation

9.4 Policy Recommendations

To complement the spatial proposals and support the ABD's envisioned economic transformation, three integrated **policy interventions** are proposed. These address land development, sectoral incentives, and long-term planning control to ensure a coordinated rollout of urban growth.

---

1. Peri-Urban Ethnomedicinal Farming Incentive

Objective:

To promote the **cultivation of ethnomedicinal crops** by farmers near the ABD, supporting agro-industries and enhancing farm-based income generation.

Implementation Period:

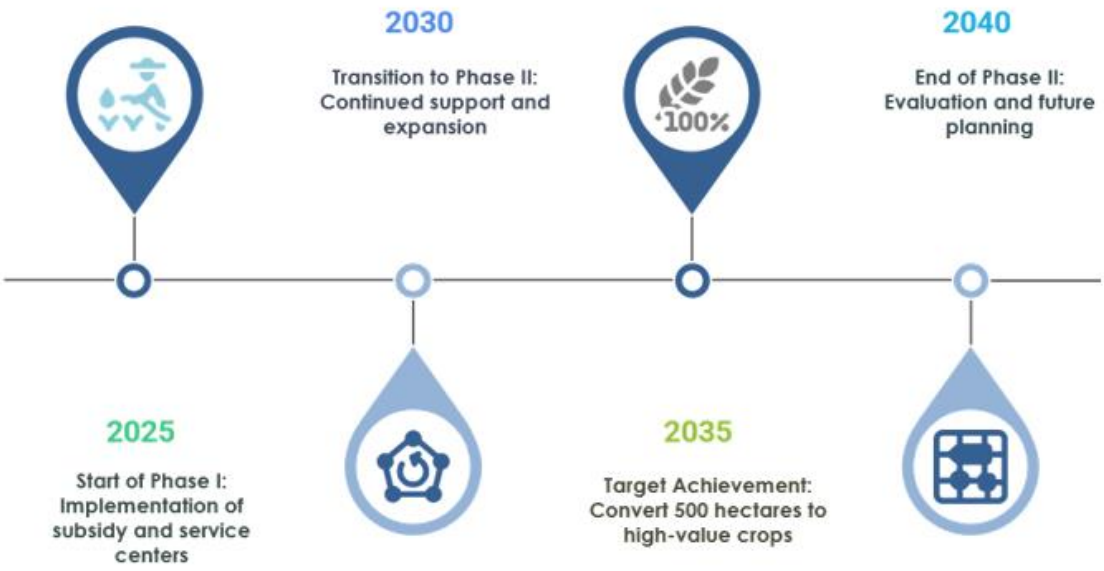
- **Phase I:** 2025–2030
- **Phase II:** 2030–2040

Key Provisions:

- Provide a **₹30,000/hectare/year subsidy** to farmers cultivating approved ethnomedicinal species.
- Set up **2 Farmer Service Centers** in the ABD periphery for **training**, **seed distribution**, and **procurement**.
- Promote **industry linkages** via cooperatives and **direct MSP contracts**.
- Target to **convert 500 hectares** within a **5 km buffer around the ABD** to high-value ethnocrop farming by 2035.

Policy Anchor:

- **Ministry of AYUSH** & **National AYUSH Mission** – plant promotion and subsidy framework.
- **Rashtriya Krishi Vikas Yojana (RKVY)** – for crop diversification and local support.
- **Department of Agriculture, M.P.** and **Chhindwara District Collectorate**, in coordination with the **Municipal Corporation** – for on-ground execution.


2025
Start of Phase I: Implementation of subsidy and service centers
2030
Transition to Phase II: Continued support and expansion
2035
Target Achievement: Convert 500 hectares to high-value crops
100%
2040
End of Phase II: Evaluation and future planning

2. Chhindwara Agro-EthnoMed Industrial Incentive

Objective:

To attract **agro-processing and herbal/pharma industries** to the ABD's industrial zone and promote employment through value-addition.

Implementation Period:

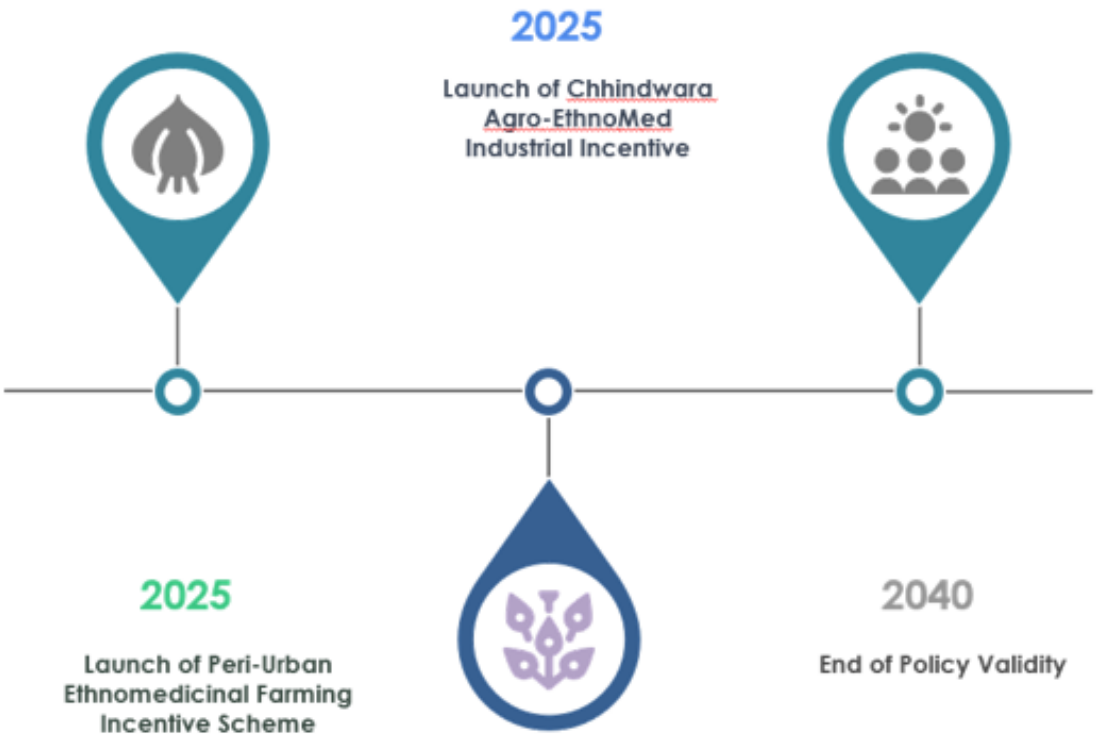
- **Launch:** 2025
- **Valid till:** 2040

Key Provisions:

- Provide **50% stamp duty exemption** and **capital subsidy up to ₹50 lakhs** for qualifying units.
- Offer **₹1/unit power tariff rebate (5 years)** and **5% interest subsidy** on long-term loans.
- Set up a **Single-Window Clearance Cell** for expedited licensing and investment support.

Policy Anchor:

- Linked with **M.P. Industrial Promotion Policy 2022** and **MSME Development Schemes**.
- Herbal industries supported through the **AYUSH Cluster Scheme**.
- Implementation by **District Industries Centre (DIC), Chhindwara**, monitored by **MPIDC** (M.P. Industrial Development Corporation).



3. Phased Corridor Reservation and Development

Objective:

To reserve and develop a **45-meter-wide road corridor** in stages—enabling controlled growth and **future-proof urban mobility**.

Implementation Period:

- **Acquisition:** 2025–2030
- **Construction of 30m ROW:** 2030–2035
- **Widening to 45m:** 2040–2045

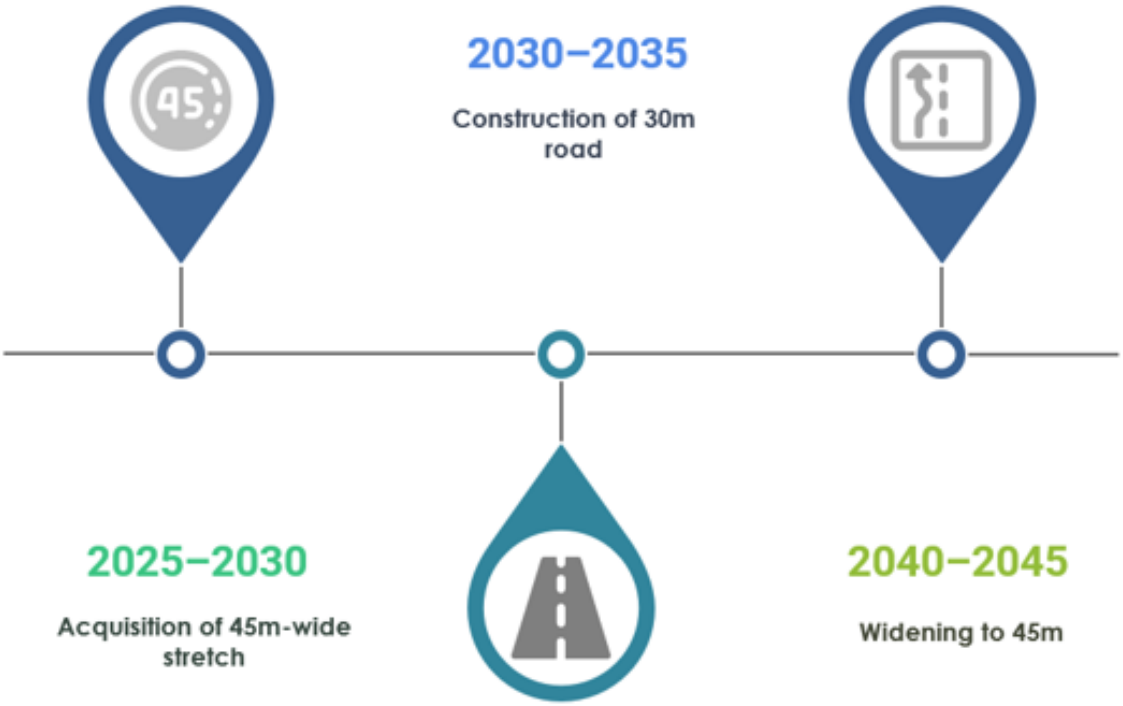
Key Provisions:

- Acquire **45m corridor** via **Town Planning Scheme or land pooling**; build **30m wide roads** initially.
- Reserve remaining **15m for green buffers, utilities, or transit systems**.
- Provide **Transferable Development Rights (TDRs)** up to **1.5x of surrendered land** to incentivize cooperation.

Policy Anchor:

- Legal framework from **M.P. Bhumi Vikas Rules 2012** and **M.P. Town and Country Planning Act 1973**.

- Backed by **AMRUT 2.0 guidelines** and **State Road Development Authority policies**.
- Executed by **Chhindwara Municipal Corporation** and **Town and Country Planning Directorate**.



These policies serve as critical enablers for **economic clustering**, **sector-specific industrialization**, and **sustainable land development**, ensuring that the ABD proposal is **institutionally viable and economically productive** over the long term.

9.5 Guided Landcover Projection using *Cellular Automata*

Overview of Methodology

To assess the impact of proposed physical interventions, a guided landcover projection was carried out using the **Cellular Automata model integrated with Artificial Neural Networks (ANN)**. This model simulated urban expansion for Chhindwara by the year 2045 under structured development conditions.

The ANN was trained on **5000 randomly sampled pixels**, using **three hidden layers**, a **learning rate of 0.001**, **momentum of 0.050**, and **500 training iterations**. The model demonstrated high performance with a **validation Kappa coefficient of 0.8622** and a **minimum validation error of 0.01378**. The learning curve showed **consistent error reduction**, confirming reliable training and strong generalization for predicting landcover transitions.

Analysis of Spatial Outputs

Projected Urban Expansion (2035 and 2045)

The simulation results for 2035 and 2045 display a **compact, well-structured growth pattern** as opposed to earlier sprawl-based projections. The projected built-up areas are densely clustered and aligned with the proposed infrastructure network, particularly the **24m and 30m arterial and collector roads**, suggesting that the land use zoning and road hierarchy effectively influence development direction.

By 2045, the built-up form demonstrates:

- **Spatial continuity** without fragmentation or leapfrogging development,
- **Linear and radial growth** guided by the proposed road network,
- **Reduced isolation in peripheral zones**, indicating better urban integration.

Improved Land Absorption and Connectivity

Peripheral greenfield regions, which remained underutilized in earlier scenarios, now display **higher rates of land absorption**. This is attributed to the introduction of structured grid roads, improved accessibility, and planned land use allocation. Areas previously

vulnerable to disorganized growth have now become **well-integrated and development-ready** zones.

Corridor-Based Development Pattern

The spatial pattern reflects a strong orientation along:

- **Inner ring road alignments**,
- **Designated commercial and mixed-use corridors**,
- **Transport and TP Scheme frameworks**.

This confirms that **zoning-based interventions and physical restructuring** are effective in channeling growth toward infrastructure-supported zones while preserving sensitive or ecologically unsuitable areas.

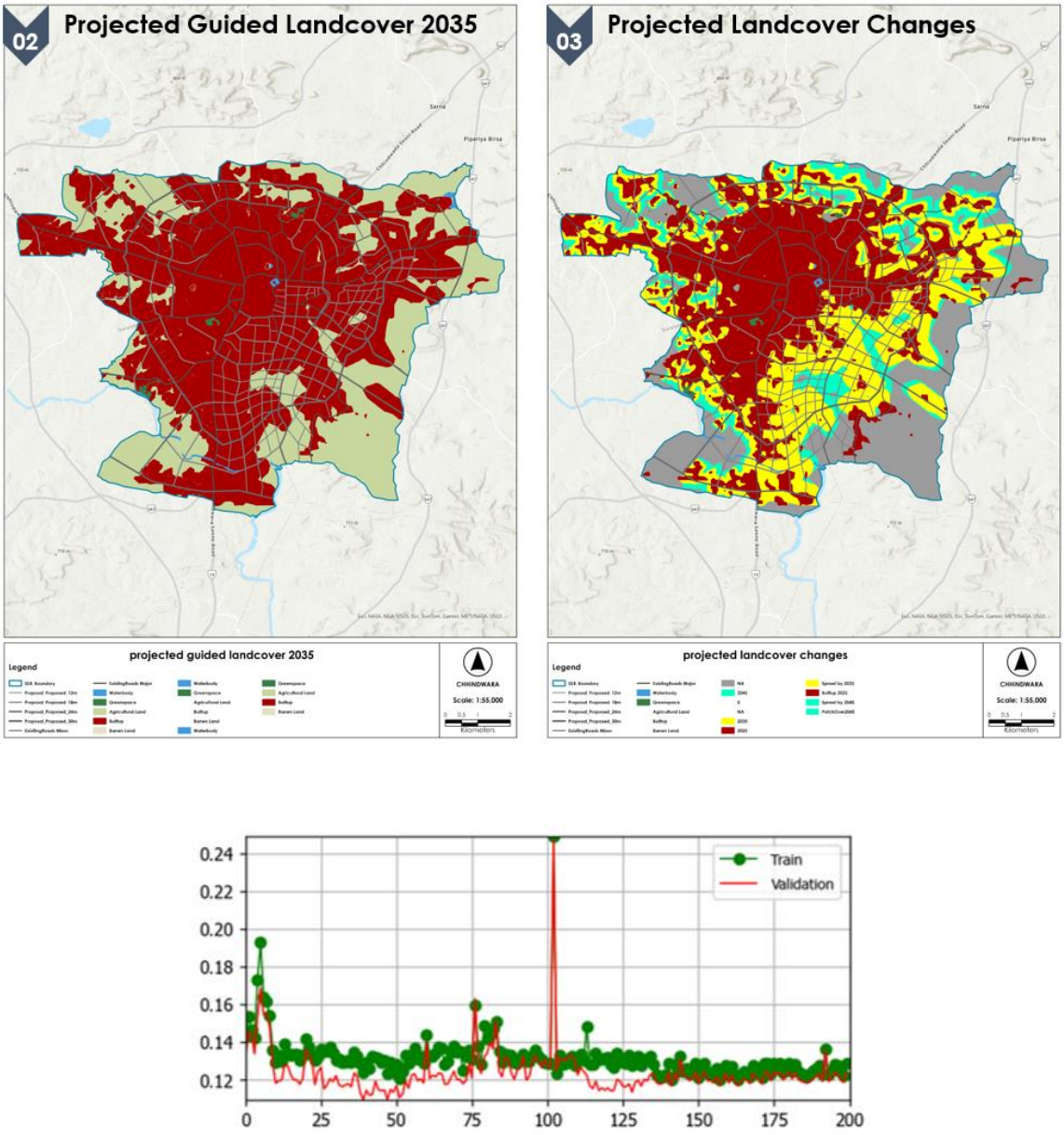


Figure 65 projection of guided landcover changes and graph showing learning curve of neural network training

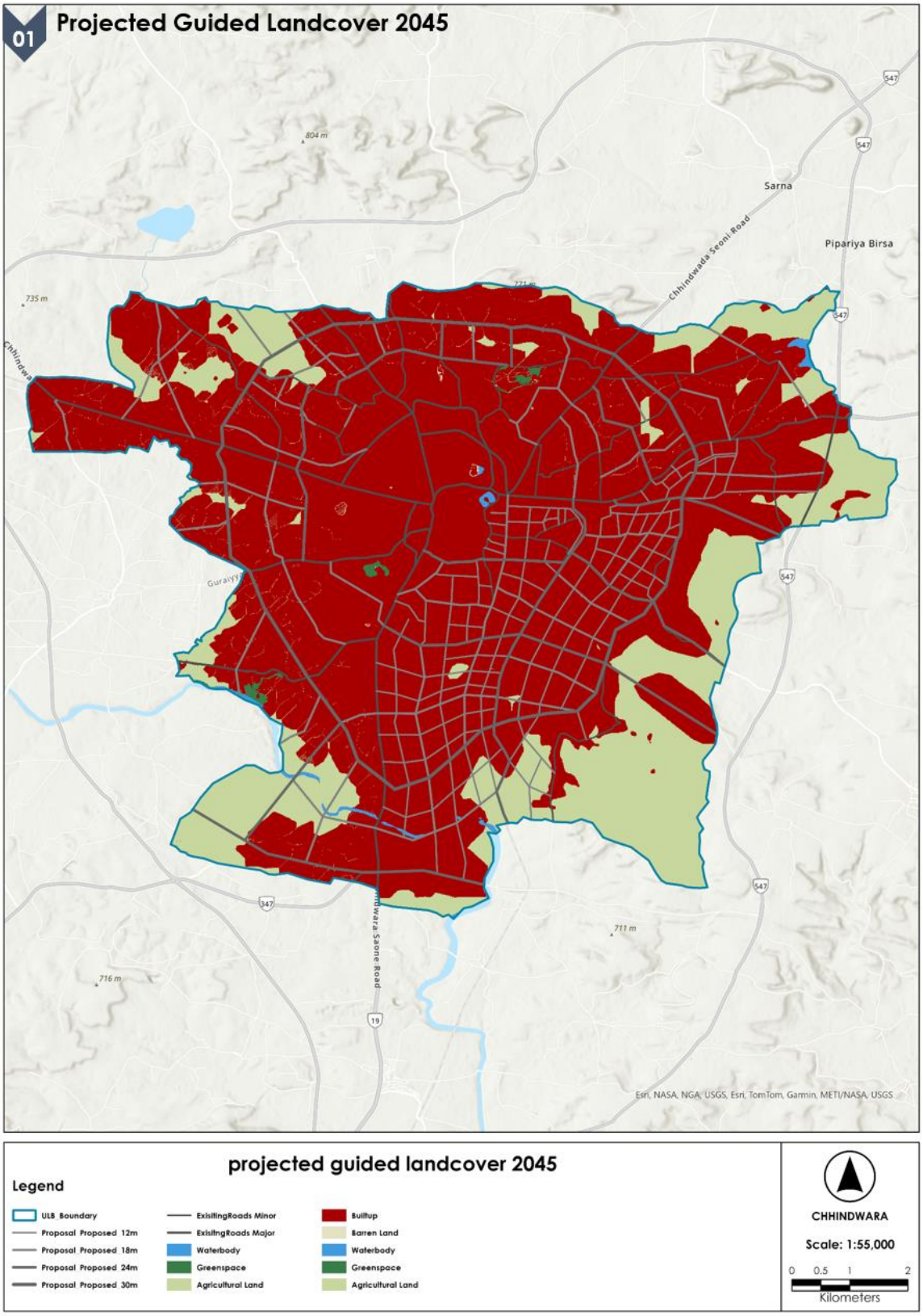


Figure 66 projected guided landcover 2045

9.6 Comparative Analysis

This study simulates two distinct landcover growth scenarios for Chhindwara city up to the year 2045: one following the **proposed guided planning framework** and the other reflecting **unguided organic growth**. The intent was to test how strategic physical and land use interventions—such as a structured road network, zoning for economic hubs, and land reconstitution—affect the future spatial form of the city.

Both scenarios were modelled using **Cellular Automata** and **Artificial Neural Networks**, trained on historic landcover and spatial influencers. The guided projection incorporated proposed road hierarchies, TP zoning, and land suitability overlays, whereas the unguided model extrapolated from existing unregulated development trends.

Key Findings from Guided vs. Unguided Projection

- **Guided growth produces spatial continuity and compact urban form**, minimizing leapfrogging and fragmentation. In contrast, the unguided scenario results in scattered, irregular growth patterns with underutilized peripheral land.
- **Robust road infrastructure** in the guided model creates a **clearly defined hierarchy**—including inner ring roads, 24m arterials, and 18m-12m collectors. This supports structured zoning, utility distribution, and accessibility. In the unguided scenario, road influence is weak, leading to **isolated growth pockets**.
- **Strategic placement of economic attractors**, particularly **industrial and commercial land uses within the ABD area**, stimulates planned development in their vicinity. These zones visibly anchor growth in the guided model, highlighting the role of land use planning in directing spatial expansion.
- **Infrastructure-led growth** enables **efficient plot subdivision, TP scheme implementation, and land pooling**, which are essential for peri-urban transformation. In contrast, the unguided projection lacks land management logic, resulting in incoherent, haphazard urbanization.
- **Service and utility integration improves under guided conditions**, especially along corridors and near PSP zones. The unguided model fails to form functional clusters, straining future transit and utility planning due to its unpredictable form.

Landcover Change Patterns (2025–2045)

The **landcover change maps** reveal that:

- Under the **guided scenario**, change is densified along major roads and zone-based allocations, creating **high-efficiency development corridors**.
- The **unguided model** shows high land consumption but lower spatial logic, with **dispersed growth in ecologically or logistically unfit areas**, increasing future costs of infrastructure extension.

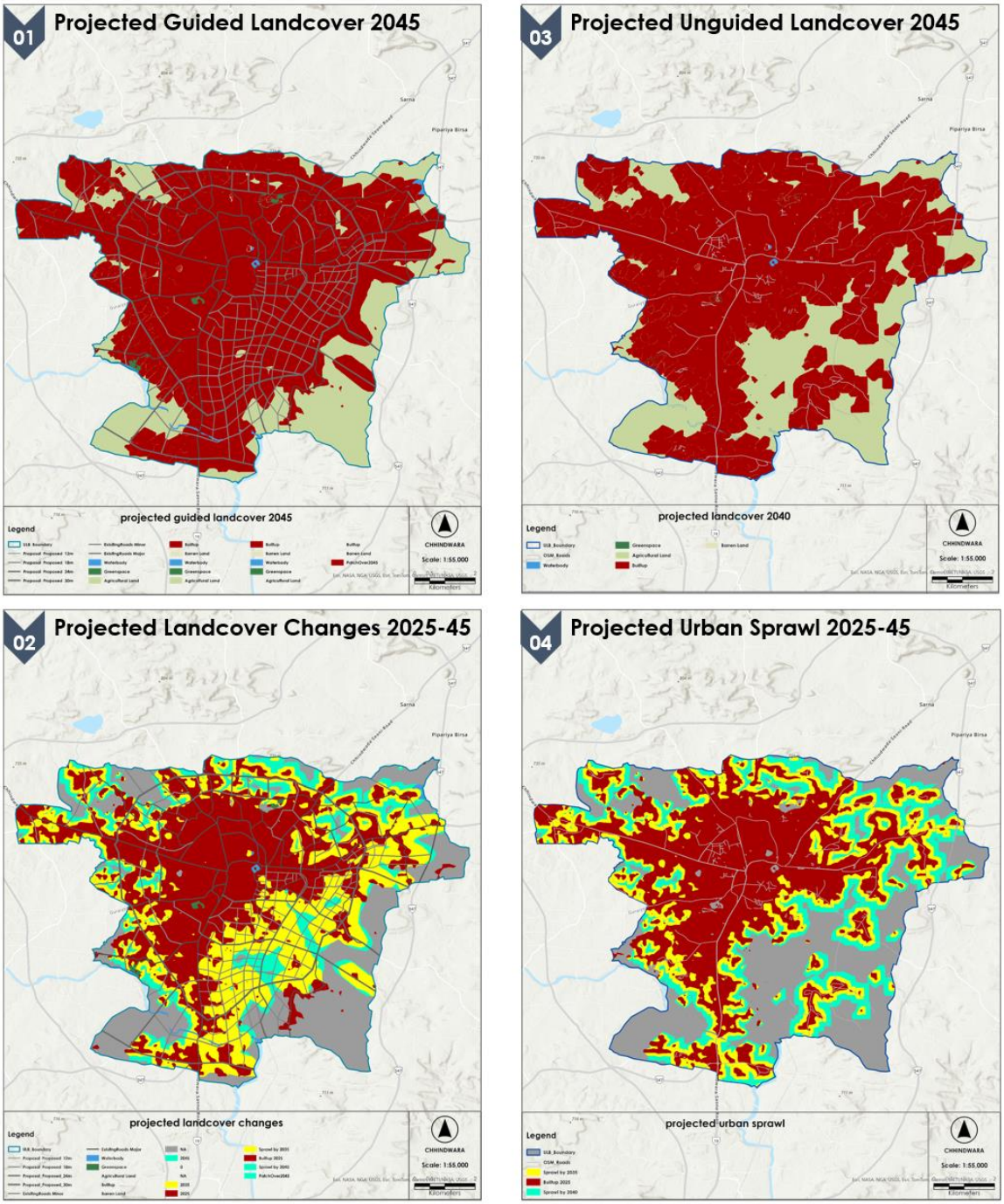


Figure 67 comparison maps of guided and unguided landcover projections 2045

9.7 Way Forward

This simulation successfully demonstrates how **planned land use zoning and physical interventions**—when executed through TP Schemes, road hierarchies, and zoning regulations—can **channel urban growth efficiently**. While both models forecast a built-up increase, only the guided projection aligns with sustainability goals and infrastructure capacity.

The results affirm that **small towns like Chhindwara**, which are vulnerable to unmanaged fringe expansion, require **planning-led development** strategies. These findings can be extended to other towns facing similar issues, proving the relevance of simulation-based projections in guiding land use policy and infrastructure investment.

Given the **academic data constraints**, the study's scope remained limited; however, the methodology has strong **replicability**. Future studies can enhance this framework using detailed parcel-level data, mobility modelling, and stakeholder consultation to improve **planning realism and implementation accuracy**.

Chapter – 10

Summary

This thesis investigates a **guided urban growth strategy** for *Chhindwara*, a fast-growing Tier-3 city in Madhya Pradesh, currently facing **spatial fragmentation, leapfrog development**, and **infrastructure stress** in its peri-urban regions. The core objective of the study is to **channel urban expansion** through structured **physical planning** approaches, using tools like **Area-Based Development (ABD)**, **Town Planning (TP) Schemes**, and **policy incentives**, all underpinned by **data-driven spatial analysis** and **landcover projection simulations**. This multi-layered approach aims to shift the city's development trajectory from uncoordinated sprawl to **balanced, economically productive, and infrastructure-efficient growth**.

The research began by studying **past landcover trends (2015–2025)** using satellite-derived raster datasets, which revealed a pattern of increasing **built-up area replacing agriculture and open land**. These trends demonstrated the urgency for guided interventions. To determine where such intervention would be most effective, the study conducted a **Land Suitability Analysis** using key raster layers—**slope, aspect, natural drainage, road proximity, land values, and parcel sizes**. Areas in the **southern and southeastern belts** of Chhindwara emerged as the most suitable, owing to **flat topography, minimal flood risk, good accessibility**, and **large, contiguous land parcels**. These findings helped delineate a **12.62 sq.km ABD area**, selected as a pilot zone for the proposed interventions.

The next phase involved formulating a **Schematic Road Network**, which corrected existing inefficiencies like **abrupt dead-ends**, **poor concentric connectivity**, and **underutilized land blocks**. A new **30-meter-wide inner ring road** was proposed, supported by a hierarchy of **24m arterial roads**, **18m collectors**, and **12m local roads**. This grid was designed to **subdivide large greenfield parcels**, **enable land pooling**, and **prepare the area for zoning and TP Scheme implementation**. The road layout not only established physical structure but also guided subsequent **land-use allocations**.

The **ABD zoning proposal** was constructed iteratively, beginning with dedicated

industrial zones on the southern edge. One of these zones focused specifically on **ethnomedicinal and agro-processing industries**, formalizing Chhindwara's existing **informal herbal trade** and creating a structured economic cluster linked to the **railway freight corridor**. **Commercial corridors** were then aligned along **24m arterials and highway junctions**, providing for **retail hubs, offices, malls**, and **regional trade**. **Public and semi-public institutions** were placed alongside commercial belts to form a **secondary civic core**, hosting **schools, hospitals, government offices**, and a **sewage treatment plant** along the **Kulbehra River**. Two **transport hubs** were introduced—one at the **ring-road junction** and another along the **rail line**—to support freight and bus connectivity. For housing, **Mixed-Use Residential R1 zones (14%)** were planned along commercial corridors to promote **high-density, transit-oriented living**, while **General Residential R2 zones (30%)** covered quieter interiors for **low-rise housing**. Finally, **Recreational Green Zones (12%)** were integrated as ecological buffers and social spaces, reflecting a strong emphasis on **environmental sustainability**.

To operationalize this land use plan, the ABD was subdivided into **15 TP Schemes** under a **three-phase development strategy**. **Phase I** (high built-up, 40%) targeted existing fringe areas for early intervention. **Phase II** (medium built-up, 20%) included emerging urban pockets meant for mid-term expansion. **Phase III** (greenfield, <10% built-up) was reserved for **long-term growth**, ensuring **orderly, phased urbanization**. This TP framework ensures that **land readjustment, public infrastructure**, and **zoning enforcement** can be carried out **sequentially**, maintaining control over future development.

To support these physical proposals, the thesis recommends three **policy incentives**. First, a **Peri-Urban Ethnomedicinal Farming Incentive** offers farmers ₹30,000/ha and support services to promote cultivation of approved crops, helping **integrate agriculture with industry**. Second, a **Chhindwara Agro-EthnoMed Industrial Incentive** provides **capital subsidies, stamp duty waivers**, and **power rebates** to attract industries to the proposed cluster. Third, a **Phased Corridor Development Policy** proposes early acquisition of **45-meter-wide corridors**, building **30m roads initially** while reserving **15m for future utilities and widening**, supported by **Transferable Development Rights (TDRs)** and AMRUT 2.0 provisions.

The robustness of the plan was tested through a **Cellular Automata-based landcover projection**, using **Neural Networks trained on historical land use data and proposed interventions**. The model compared **guided vs. unguided urban growth**. The **guided scenario**, with road and zoning inputs, resulted in **compact, contiguous, and service-efficient development**, especially in peripheral areas. In contrast, the **unguided scenario** produced **fragmented sprawl**, disjointed from infrastructure and inefficient for service delivery. The model achieved **high accuracy (Kappa = 0.8622)**, validating the effectiveness of **planning-led urban development**.

In conclusion, this thesis offers a **replicable and scalable model** for managing small-town growth through **data-backed planning, phased execution**, and **economic alignment**. It not only proposes physical solutions but also embeds them within **policy frameworks** and **simulation models**, proving that with the right tools, **unregulated expansion** can be redirected into **productive, structured urbanization**. The approach provides a viable template for **other Indian towns** facing similar peri-urban challenges, demonstrating that strategic planning—when backed by **spatial logic, land management**, and **institutional support**—can indeed shape the future of growing urban landscapes.

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